



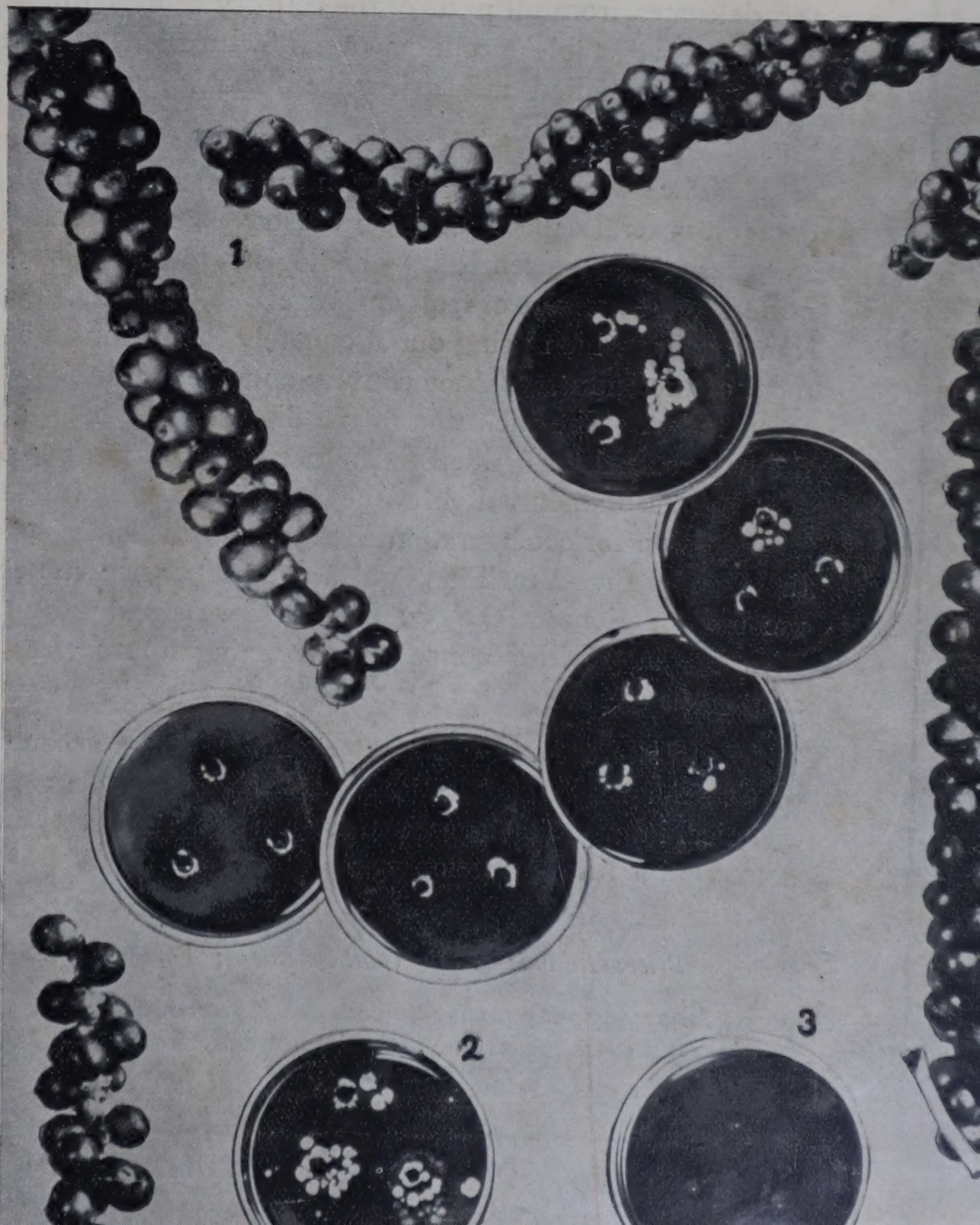
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FOOD SCIENCE

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BULLETIN OF THE CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE



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STUDIES ON THE NUTRITIVE VALUE OF BALANCED MALT FOODS

By M. R. CHANDRASEKHARA, M. SWAMINATHAN, A. N. SANKARAN AND V. SUBRAHMANYAN
(Central Food Technological Research Institute, Mysore)

In a country like India where the *per capita* production of milk is low, the problem of supplying adequate nutrition to the weaned infants and children has become very acute¹. Because of the undernourished condition of the mother, the infant is very often deprived of adequate supply of mother's milk. The need for supplementary foods like cow's or buffalo's milk becomes greater as the infant advances in age. Due to the scarcity and high cost of milk and other protective foods the children of the poorer classes after weaning are generally fed on cooked cereals or cereal gruels, both of which have a low protein content and are deficient in many essential vitamins and minerals. The incidence of protein malnutrition and vitamin deficiency diseases is consequently quite high among the children of the poorer classes^{2,3}. Investigations carried out by Chick and Slack⁴ and later by Dean⁵ have shown that a highly nutritious food can be prepared by blending barley malt extract with soyabean flour. With a view to meeting the shortage in the supply of milk, investigations were undertaken in this Institute for preparing balanced

malt foods by blending a mixture of cereal malt, groundnut flour and skim milk powder with adequate quantities of vitamins and minerals⁶. In an earlier paper from this laboratory⁷, it was reported that a low cost malt food⁶ when incorporated at 10 per cent level, possessed a marked supplementary value to poor rice diet. The present note deals with studies on the nutritive value of three samples of malt foods based on *jowar* (*Sorghum vulgare*), wheat and *ragi* (*Eleusine Coracana*) malt.

The method adopted for the preparation of malt foods was briefly as follows: Malts from wheat, *ragi* and *jowar* were prepared according to conventional methods in vogue for the preparation of barley malt⁸. The malted grains were dried and freed from the adhering vegetative portion by hand-pounding and winnowing. The malted grains were then powdered and passed through a 70 mesh sieve. Low fat groundnut flour was prepared according to the method of Subrahmanyam *et al*⁹. Malt foods containing the three cereal malts were prepared by blending in suitable proportions the malt flour with low fat groundnut flour, skim milk powder, hydrogenated fat and sugar according to the method described in Indian Patent No. 51525 (1954)⁶. The products were fortified by the addition of essential vitamins and minerals. For the comparison of the nutritive values of the malt foods, milk foods containing the same amounts of protein, vitamins and minerals as the malt foods were prepared by mixing skim milk powder with cane sugar, corn starch, hydrogenated fat and fortifying the product with vitamins and minerals (calcium, iron and copper). The chemical composition of the malt foods and the milk food as compared with those of skim and whole milk powders are given in Table I. The proximate principles and minerals were determined according to the methods of A.O.A.C.¹⁰. The vitamins (except Vitamin D) were assayed according to the methods of the American Association of Vitamin Chemists¹¹.

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TABLE I. *Chemical composition of malt food and a milk food as compared with skim milk and whole milk powders*

| Constituents | Wheat malt food | Jowar malt food | Ragi malt food | Milk food (1) | skim milk powder (2) | Whole milk powder (2) |
|------------------------------|-----------------|-----------------|----------------|---------------|----------------------|-----------------------|
| Moisture ... | 3.6 | 3.8 | 3.9 | 3.8 | 3.5 | 3.5 |
| Protein (Nx 6.25) %... | 24.6 | 24.2 | 24.3 | 25.0 | 35.6 | 24.6 |
| Fat % ... | 6.1 | 6.8 | 6.2 | 6.0 | 1.0 | 30.0 |
| Ash % ... | 5.8 | 5.8 | 6.1 | 5.0 | 7.9 | 5.7 |
| Carbohydrate (by diff) % ... | 59.9 | 60.0 | 59.5 | 60.2 | 52.0 | 36.2 |
| Calcium (as Ca) % ... | 1.22 | 1.16 | 1.14 | 1.08 | 1.3 | 0.90 |
| Phosphorus (as P) % ... | 0.87 | 0.86 | 0.84 | 0.86 | 1.03 | 0.69 |
| Iron (as Fe) mg. % ... | 1.89 | 2.12 | 1.92 | 1.9 | 0.6 | 0.60 |
| Vitamin A. I.U. | 5,000 | 5,000 | 5,000 | 5,000 | 40 | 1570 |
| Vitamin D. I.U. | 400 | 400 | 400 | 40 | ... | 8-160 |
| Thiamin mg % | 1.54 | 1.52 | 1.55 | 1.51 | 0.35 | 0.29 |
| Riboflavin mg. % ... | 1.56 | 1.58 | 1.53 | 1.55 | 1.6 | 1.39 |
| Nicotinic acid mg. % ... | 10.8 | 10.6 | 10.4 | 10.3 | 1.1 | 0.7 |

1. A blend of skim milk powder 69 parts, Corn starch 12 parts. Sugar 12 parts, hydrogenated fat 3.6 parts, groundnut oil 2.4 parts fortified with vitamins as in the other malt foods and with added iron and copper.

2. Agricultural Hand Book No. 24, "Composition of Foods used in Far Eastern Countries" published by Bureau of Human Nutrition and Home Economics, U.S.A., 1952.

The relative nutritive values of the malt foods as compared with those of the milk foods were determined by the rat growth method¹². Four groups of freshly weaned Albino rats, about 4 weeks old and weighing 40-45 g. each, were used for the experiments. The rats were distributed equally among the different groups with respect to sex, weight and litter-mates. The different groups of rats were fed *ad lib* on (1) wheat malt food, (2) jowar malt food, (3) ragi malt food and (4) milk food. Weighed amounts of malt foods and milk foods were taken in feeding cups and mixed with 3 parts by weight of boiling water, allowed to cool and fed to the animals. Records of food intakes were maintained for each animal. The animals were weighed weekly. The duration of the experimental period was eight weeks. The results are given in Table II.

The results on statistical analysis showed that the average growth of rats on the malt foods was significantly higher than that observed on the milk food. The skim milk powder used in these experiments for the preparation of malt and milk foods was a commercial sample and had an acceptable taste. Its solubility in water was about 85 per cent and there was no evidence of deterioration of its quality. The lower growth rate observed on the milk food might be due to the lower food intake of rats on the diet. When

TABLE II. *Average weekly growth of rats during 8 weeks on malt foods containing Jowar, Wheat and Ragi Malts and on a Milk Food*

| Diet | No. of animals & sex. | Average initial body wt. (g) | Average weekly gain in wt. | | | Average weekly food intake | | | Adjusted gain in weight per week (g) | |
|-------------------|-----------------------|------------------------------|----------------------------|-----------------|-----------------|----------------------------|-----------------|-----------------|--------------------------------------|-------------|
| | | | Both sexes (g) | Males (g) | Females (g) | Both sexes (g) | Males (g) | Females (g) | Males (1) | Females (2) |
| Wheat Malt Food | 3M + 4F | 45.9 | 16.29 | 18.51 | 14.07 | 79.10 | 82.50 | 75.7 | 19.15±9.86 | — |
| Cholam Malt Food | 3M + 4F | 45.1 | 16.39 | 25.19 | 13.59 | 87.99 | 96.47 | 79.5 | 19.26±1.85 | — |
| Ragi Malt Food | 3M + 4F | 46.1 | 15.96 | 18.35 | 13.57 | 83.40 | 87.30 | 79.5 | 16.74±0.96 | — |
| Milk Food | 3M + 4F | 46.5 | 13.30 | 15.12 | 11.49 | 69.00 | 69.20 | 68.8 | 22.03±2.10 | — |
| Standard Error... | ... | ... | ± 0.73 (15 d.f.) | ± 1.46 (6 d.f.) | ± 0.67 (9 d.f.) | ± 1.72 (15 d.f.) | ± 2.63 (6 d.f.) | ± 2.22 (9 d.f.) | ... | — |

1. Observed gains in weight reduced to overall average food intake of 83.87 gm/week/rat, by employing a regression coefficient of 0.4707 gms gain in weight per gm. of food intake per week.

2. Correlation between gain in weight and food intake statistically not significant.

the data were analysed separately for male and female rats, a significant correlation was observed between food intake and gain in body weight for male rats and no such correlation was noticed for female rats. When the data for male rats were analysed after adjusting the body weight for equal food intake (Table II) no significant difference was observed between the four diets. The results indicate that the malt foods tested in this investigation possess high nutritive value, comparing well with a milk food having a similar composition.

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SCIENCE NOTES

STABILITY OF VITAMIN B₁₂ IN PROTEOLYSED LIVER EXTRACT

Efficacy of liver preparations in the treatment of pernicious anaemia largely depends on its vitamin B₁₂ content. Stapert and coworkers¹ have shown that vitamin B₁₂ in liver extracts loses its potency on storage. It is also often reported in the literature^{2,3} that vitamin B₁₂ content of liver extracts sold in the market, is highly variable and is frequently below the label claims. There is, however, very little information available on the factors influencing the deterioration and on the conditions ensuring the maximum stability of vitamin B₁₂. A systematic study was therefore undertaken in this Institute on these aspects. Preliminary data obtained in this study are reported in this communication.

The liver digest used in these studies was prepared as follows: Fresh liver was homogenised with 3 times its weight of water and digested with papain at 60°C. for 8 hours. It was next filtered, concentrated in vacuum to half its volume and again filtered. The clear filtrate was used for storage trials. The digest was stored with toluene as a preservative in plain glass bottles under different conditions indicated in the table

for a period of 6 months. The bottles were stored at room temperature (25–28° C) in the laboratory shelf. The vitamin B₁₂ potency was measured at different intervals microbiologically using *L-leichmannii* as the test organism according to the method of Sreenivasamurthy *et al.*⁴ The results are presented in the accompanying table.

Changes in the vitamin B₁₂ potency of proteolysed liver extract during storage under different conditions

| Storage period (months) | Half-filled bottles m μ g/ml. | Completely filled bottles m μ g/ml. | Half-filled and stored under nitrogen m μ g/ml. | Half-filled and cyanide* treated m μ g/ml. |
|-------------------------|-----------------------------------|---|---|--|
| 0 | 950 | 950 | 950 | 950 |
| 1 | 800 | 940 | 940 | 950 |
| 2 | 720 | 930 | 930 | 940 |
| 3 | 600 | 920 | 920 | 930 |
| 4 | 420 | 920 | 920 | 930 |
| 5 | 300 | 910 | 910 | 920 |
| 6 | 150 | 910 | 900 | 910 |

* potassium cyanide (2 mg) was added to 100 ml. of the extract.

The results show that the digests in half-filled bottles lost nearly 84 per cent of the vitamin potency during storage for 6 months. In the completely filled bottles, on the other hand, the loss was only 27 per cent. When stored in nitrogen atmosphere the potency remained stable throughout the storage period. Addition of cyanide also had similar stabilising effect on the vitamin potency.

These results indicate that air adversely affects the stability of the vitamin. Exclusion of air from the containers as in completely filled bottles or as in bottles filled with nitrogen offers maximum protection to the vitamin. Addition of cyanide also ensures maximum stability. Cyanide is known to convert hydroxocobalamin to cyanocobalamins. Stabilising effect of cyanide may be attributed to this conversion to cyano form which is more stable than the

hydroxocobalamin. Details on the changes in the concentration of hydroxo- and cyanocobalamin in liver digests during storage and their relation to stability of the vitamin potency are being studied and the results will be published in due course.

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CHLORINATION SOLVES CORROSION AND ODOUR PROBLEMS IN PASTEURIZERS AT REDUCED COST*

In breweries or other industries where pasteurizers and water cooling equipment are employed, the use of a chlorine treatment of the water prevents the build-up of algae and slime-forming bacteria on the inside walls of the equipment at one fourth the cost of other methods.

According to the George Wiedemann Brewing Company of Newport, Kentucky, the treatment also prevents the development of odours. It increases the life of the equipment and reduces maintenance costs by killing iron-attacking bacteria which cause pitting and corrosion.

As a last resort, the chlorine was added to the suction side of the pump which feeds the heated water into the sprays of the pasteurizing compartment. The chlorine passed directly into the heat zone, thus proving successful for maintaining sufficient residual chlorine (0.25 parts per million under normal operation) to solve the bacterial accumulation problem.

Another phase of the pasteurizer-water prob-

lem was that of the high iron content in the well water used for this phase of processing. The control of iron was achieved by aerating the well water and subsequent filtration through sand and gravel filters. This treatment reduces the iron content from an original 2.5 to 3.5 parts per million to about 0.3 p.p.m.

Breakdown of the high bicarbonate content due to heat in the pasteurizer produces carbonates which would scale the equipment quickly. Control of this problem is achieved by adding sodium hexametaphosphate to the makeup water. Concentration of 4 to 6 p.p.m. is maintained at the preheating section of the pasteurizers.

This water treatment has not caused any corrosion problems since its inception. Because of high bicarbonate content (590 p.p.m.) the water maintains a pH of between 7.9 and 8.3. Used in other plants not having sufficient natural alkalinity, the addition of a small amount of alkali may be necessary.

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THE NUTRITIVE VALUE OF LOW FAT GROUNDNUT FLOUR

By V. SUBRAHMANYAN, M. NARAYANA RAO AND M. SWAMINATHAN

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In this article, the information available on low fat groundnut flour with respect to its preparation, chemical composition, amino acid composition, digestibility and biological value of its protein, metabolism trials on human beings and nutritional trials with school children has been reviewed. The use of this groundnut flour in the preparation of soup powder, Mysore Flour, composite grains, low cost malt food, Multi-Purpose Food and nutritious biscuits is described.

Considerable interest has recently been evinced in many countries in the utilisation of specially processed low fat oil seed flours as a protein supplement in human dietaries¹⁻⁶. Heat processed soya flour and grits suitable for human consumption are being manufactured in large quantities in U.S.A. Groundnut and cottonseed flours are also being produced in limited amounts⁴. In view of the shortage of both animal and vegetable proteins in the diets of people belonging to low income groups in India and other Asian countries, Africa and South America, considerable emphasis has lately been placed on the use of oil seed flours as a source of proteins in human diets⁷. In the present article, a review of the available information on the nutritive value of groundnut flour has been presented.

Preparation of edible low fat groundnut flour

Subrahmanyam *et al*⁸ have standardised the conditions for the preparation of edible groundnut flour. The method is briefly as follows:

Groundnut kernels of good quality are cleaned of foreign matter like stones, broken shells and damaged seeds. Selected kernels are then given a light roasting to facilitate the removal of the cuticle. The cuticle (testa) is removed mechanically by rubbing the kernels over a wire mesh, and blowing off the detached cuticle in a current of air. The decuticled kernels are crushed in an oil expeller to a residual oil content of about 8-10 per cent. The pressed cake is broken in a disintegrator and then ground in a flour mill to pass through a 60 mesh sieve. The groundnut flour thus prepared has a light yellow colour and a pleasant nutty odour and agreeable taste. The cost of the product has been estimated to range from As 3 to As 4 per lb. depending on the cost of the groundnut kernels.

Keeping quality of groundnut flour

The effect of storage on the keeping quality and nutritive value of edible low fat groundnut flour was studied by Subrahmanyam *et al*⁹. Groundnut flour was found to keep well during storage for five months at room temperature and at 37°C, there being no development of rancid odour. There was some increase in the fat acidity. A loss of thiamine to the extent of 20 per cent was observed. There was no deterioration in the overall nutritive value of the flour, as judged by the rat growth experiments. No appreciable change in the biological value of the proteins of groundnut flour was observed as a result of storage. Organoleptic evaluation showed that the groundnut flour was acceptable for human consumption after storage for a period of five months.

Chemical composition of groundnut flour

The chemical composition of low fat groundnut flour, as compared with certain other oil seed flours¹⁰⁻¹², as well as certain legumes and skim milk powder which have been suggested as possible supplements to poor human dietaries, is given in Table I.

It is evident from the table, that groundnut meal is a rich source of proteins and certain vitamins of the B-complex, having a composition similar to that of soya flour.

Proteins: The literature on the proteins of groundnut has been recently reviewed by Moorjani and Bhatia¹³. The major part (about 86 per cent) of the proteins of groundnut is contributed by two globulins, arachin and conarachin, first isolated and studied by Johns and Jones¹⁴⁻¹⁶. The nitrogen distribution in groundnut proteins was also studied by the same workers^{14, 16}. The essential amino acid make up of the groundnut

protein as compared with other oil seed proteins¹⁷⁻²⁰ is given in Table II. These figures indicate that as a source of all essential amino acids except methionine and threonine, groundnut proteins compare well with the proteins of other foods like milk and soya bean. Brown^{21, 22}, and Jones *et al*²³ determined the amino acid make up of arachin and conarachin, and have shown that the two differ markedly with respect to their methionine, cystine, threonine and tyrosine contents.

Carbohydrates: Low fat groundnut flour contains about 20-25 per cent of carbohydrates, of which sucrose is an important constituent²⁴. Figures are not available for the amount of various carbohydrate components present in groundnut flour. The starch content of the groundnut kernels has been reported to be 5-6 per cent²⁵. Sucrose has been reported to constitute from about 2-7 per cent of peanuts²⁶. The

presence of fair amounts of pectic material (4 per cent), cellulose (2 per cent) and hemicelluloses (4-12 per cent) has also been reported²⁷. The above constituents will be present in proportionately higher amounts in groundnut meal.

Mineral elements: Groundnut flour is rich in phosphorus, potassium and magnesium²⁴. From a dietary point of view it is deficient in calcium but adequate in magnesium and phosphorus²⁴. A greater part of the phosphorus is present in the form of phytin. Pons and Guthrie²⁸ found that peanut meal contained 0.85 per cent of total phosphorus but only 0.08 per cent as inorganic phosphorus.

Vitamins: Biological and Chemical assays for the B-complex vitamins in groundnut flour showed that the flour contains 7-9 μ g. of thiamine and 3-5 μ g. of riboflavin per gram²⁹⁻³¹. It is a rich source of nicotinic acid, containing about 20 mg. per cent³². Besides, it has been reported

TABLE I. Chemical composition of low fat groundnut flour as compared with certain other protein rich foods

| Description of materials | Moisture % | Protein % (Nx 6.25) | Ether ex- tractives % | Carbo- hydrate % | Crude fibre % | Ash % | Calcium % | Phosphorus % | Iron mg % | Thiamine mg. % | Nicotinic acid mg. % | Riboflavin mg. % |
|---|------------|------------------------|-----------------------------|---------------------|------------------|-------|-----------|-----------------|-----------|-------------------|-------------------------|---------------------|
| Soyabean flour ⁴ (low fat) | 5.0 | 50.0 | 7.0 | 31.0 | 2.5 | 5.5 | 0.33 | 0.62 | 20.0 | 0.70 | 5.7 | 0.38 |
| Groundnut flour ⁶ (low fat) | 11.0 | 52.7 | 8.9 | 21.8 | 1.0 | 4.6 | 0.07 | 0.50 | 2.9 | 0.95 | 19.5 | 0.20 |
| Sesame flour ⁵ (low fat) | 5.6 | 33.3 | 12.2 | 38.1 | 4.8 | 6.0 | 2.38 | 0.63 | 19.3 | 1.05 | 5.3 | ... |
| Cottonseed flour ¹⁰ (alcohol extracted) ... | 9.2 | 52.1 | 5.5 | 25.8 | 1.5 | 5.9 | 0.36 | 0.82 | 12.0 | 0.99 | ... | ... |
| Cocoanut flour ⁵ (low fat) | 11.2 | 20.9 | 13.3 | 39.2 | 10.5 | 4.9 | 0.16 | 0.49 | 5.7 | 0.17 | 4.1 | ... |
| Bengal gram flour ¹ ... | 11.2 | 22.5 | 5.2 | 58.9 | ... | 2.2 | 0.07 | 0.31 | 8.9 | 0.45 | ... | ... |
| Skin milk powder ² ... | 4.1 | 35.0 | 1.0 | 51.0 | ... | 6.8 | 1.30 | 1.03 | 0.6 | 0.35 | 1.1 | 1.39 |

TABLE II. Amino acid composition of groundnut proteins as compared with the proteins of some other common foodstuffs
(calculated at 16.0 g. of nitrogen)

| Amino acids (gms) | Rice | Wheat | Jowar | Bengal gram | Soya bean flour | Groundnut flour | Sesame flour | Cottonseed flour | Cocoanut flour | Whole milk protein |
|-------------------|------|-------|-------|----------------|--------------------|--------------------|-----------------|---------------------|-------------------|-----------------------|
| Arginine ... | 7.2 | 4.3 | ... | 6.9 | 7.3 | 11.3 | 8.7 | 11.3 | 10.8 | 4.2 |
| Histidine ... | 1.7 | 2.1 | 1.6 | 2.3 | 2.9 | 2.1 | 1.5 | 2.7 | 2.4 | 2.6 |
| Lysine ... | 3.2 | 2.7 | 3.4 | 6.4 | 6.8 | 3.0 | 2.8 | 3.5 | 5.80 | 8.7 |
| Tryptophane ... | 1.3 | 1.2 | 1.22 | 0.6 | 1.4 | 1.0 | 1.8 | 1.3 | ... | 1.5 |
| Phenylalanine ... | 5.0 | 5.1 | 5.1 | 5.0 | 5.3 | 5.1 | 8.0 | 6.0 | 4.0 | 5.5 |
| Methionine ... | 3.0 | 2.5 | 1.7 | 1.7 | 1.7 | 1.0 | 3.2 | 1.7 | 2.0 | 3.2 |
| Threonine ... | 3.3 | 3.3 | ... | 4.8 | 3.9 | 1.6 | 4.0 | 3.0 | ... | 4.7 |
| Leucine ... | 8.2 | 7.0 | 12.92 | 8.0 | 8.0 | 6.7 | 7.5 | 6.0 | 7.3 | 11.0 |
| Iso-leucine ... | 5.2 | 4.0 | 6.09 | 6.0 | 6.0 | 4.6 | 4.8 | 4.0 | 5.3 | 7.5 |
| Valine ... | 6.2 | 4.3 | 5.91 | 5.4 | 5.3 | 4.4 | 5.1 | 4.8 | 5.3 | 7.0 |

to be a good source of pyridoxine, pantothenic acid, choline and vitamin E³³.

Supplementary value of groundnut flour to different diets

Kuppuswamy *et al*⁵ studied the supplementary value of groundnut flour to poor vegetarian diets mainly based on cereals. They observed that at 10 per cent level, groundnut flour had a good supplementary value to a diet based on wheat but very little supplementary value to rice diet. Murthy *et al*⁶ and Subrahmanyam *et al*³⁴ reported that groundnut flour at 20 per cent level has a marked supplementary value to diets mainly based on tapioca and sweet potato flours. Young *et al*³⁵ showed the presence of an unidentified factor in groundnut flour which is required for growth in chicks.

Digestibility and biological value of groundnut proteins

Johns and Finks³⁶, Eddy and Eckmann³⁷, and Jones and Divine³⁸ have shown that the addition of 10-25 per cent of groundnut meal to wheat flour considerably enhanced the nutritive value of wheat flour protein. Smuts and Marais³⁹ observed that proteins of groundnut flour had a good supplementary value to those of oat meal. Sure⁴⁰ reported that groundnut proteins supplement those of maize to a significant extent. Shiba and Koyma⁴¹ reported that groundnut protein has a high growth promoting value in rats when fed at 14 per cent level in the diet. Rama Rao *et al*⁴² reported a protein efficiency ratio of 1.45 for groundnut proteins at 10 per cent level of intake. They also reported that the proteins of groundnut supplemented to a significant extent those of Bajra (*Pennisetum-typhoides*). Moorjani and Subrahmanyam⁴³ found that the proteins of a milk substitute prepared from a mixture of groundnut and soya bean in the ratio of 3:1 were as good as casein in promoting the formation of blood proteins. Maynard, Fronda and Chen⁴⁴ reported that the protein efficiency ratio of peanut meal to be higher than that of corn meal at a protein level of 9 per cent and that there was moderate supplementary relation between the proteins of these two foods. The proteins of groundnut have been shown by Baernstem⁴⁵ to be approximately equal to casein in

promoting the growth of rats, when fed at 20 per cent level in the diet. The same worker has shown that conarachin, when fed as the sole source of protein promoted good growth in rats. Sure⁴⁶ reported that conarachin supplemented arachin nutritionally. Smuts and Marais⁴⁷, Grau⁴⁸ and Baernstem⁴⁹ reported that groundnut meal is deficient in methionine.

Pian⁵⁰, reported a biological value of 59 for groundnut protein at 10 per cent level of protein intake. Mitchell, Burroughs and Beadles⁵¹ reported a biological value of 58 for groundnut protein at 7.6 per cent level from experiments on rats. Morrison⁵² reported a value of 89 for the digestibility co-efficient of groundnut protein. Mitchell and Beadles⁵³ in their experiments on rats, found that the true digestibility of the proteins of raw groundnut was 97.4 per cent, and its biological value 57.9. According to the investigations carried out by Guggenheim and Edith⁵⁴, the ability of the groundnut proteins when fed at 9 per cent level in the diet, to regenerate liver protein was higher than that of fish, maize and wheat, and lower than that of casein and whole egg. Cama and Morton⁵⁵ reported that moderate heat treatment as that involved in the preparation of expeller groundnut cake improved slightly the biological value of its proteins.

Human feeding experiments with groundnut flour

Hawley *et al*⁵⁶ studied the nitrogen balance in nine subjects fed on diets in which the protein was supplied only by groundnut flour. During a nine day collection period, during which the subjects were fed daily 30.6 g. of groundnut protein on the average, the average daily intake of nitrogen was 4.90 g. and the total excretion was 5.04 g. The subjects maintained a very slight negative nitrogen balance which was probably due to insufficient protein intake. They reported a figure of 99 for the co-efficient of digestibility and 56 for the biological value of groundnut protein. Murlin *et al*⁵⁷ reported the digestibility co-efficient of groundnut protein to be 73 in human subjects. From the above results it can be concluded that when consumed in adequate amounts as the sole source of nitrogen in the diets, groundnut proteins can maintain nitrogen balance in adult human subjects. Lal⁵⁸ studied

the supplementary value of groundnut flour to the diets of school boys between the ages of 6 and 14 years. The boys were given daily 1 oz. supplement of groundnut flour in addition to their usual diet which was based mainly on rice. The feeding was continued for a period of 6 months. The results showed that supplementation of the diet of children with 1 oz. of groundnut flour daily, increased the height, weight and haemoglobin percentage to a significant extent as compared with the control not receiving the supplement.

Uses of edible groundnut flour

Low fat groundnut flour has been used in the preparation of soup powder⁵⁹, Mysore flour⁶⁰⁻⁶¹, composite grains⁶²⁻⁶⁴, low cost malt food⁶⁵, Multipurpose food⁶⁶ and nutritious biscuits (Subrahmanyam *et al*—unpublished).

Soup powder: Harris *et al*⁵⁹ developed a dehydrated soup mixture incorporating a low fat groundnut flour at 30 per cent level with low fat soya flour, precooked pea flour, skim milk powder with added flavours and condiments and fortified with essential minerals and vitamins. They reported that supplementation of the diet of children with one ounce of the soup mixture daily, brought about a considerable improvement in their nutritional status.

Mysore flour: A mixture of 25 parts of the groundnut flour and 75 parts of tapioca flour (known as Mysore flour) has been successfully used as a partial substitute for cereals in large scale feeding experiments in distress areas of Madras State⁶⁰. The gruel prepared out of Mysore flour was highly acceptable to the recipients. Institution feeding experiments⁶¹ carried out for a period of six months on 48 girls aged 6-10 years showed that 50 per cent of cereals in poor vegetarian diets could be replaced by an equal quantity of Mysore flour (mixture of 75 parts of tapioca flour and 25 parts of groundnut flour) without adversely affecting the growth, general health and nutritional status of the children. The above investigations have shown that Mysore flour can be used with advantage as a partial substitute for cereals in the human dietaries in countries having food shortage in times of emergency and in normal times.

Composite grains: Low fat groundnut flour in

admixture with tapioca flour has been used for the preparation of grain substitutes which can be used as partial substitutes for rice and other grains in our diets⁶²⁻⁶⁴. Animal experiments indicated that a diet based on composite grains prepared from a blend of tapioca flour, groundnut flour and refined wheat flour (in the ratio of 60:15:25) is significantly superior to milled rice diet in its overall nutritive value as judged by the growth of rats⁶⁴.

Low cost Malt food: Chandrasekhara *et al*⁶⁵ described the preparation of a low cost malt food suitable for feeding weaned infants by blending a mixture of cereal malt, low fat groundnut flour and skim milk powder and fortifying the product with essential vitamins and minerals. When incorporated at 10 per cent level in a poor vegetarian diet based on rice, the product has been found to make up the deficiencies in the diet and produce a marked improvement in the growth promoting value of the diet.

Multi-purpose Food: Groundnut flour has been used as a base in the preparation of a multipurpose food (a low cost protein food) fortified with vitamins and minerals and similar in nutritive value to the multipurpose food prepared by the Meals for Millions Foundation in U.S.A.⁶⁶ The product contains 75 parts of specially processed white groundnut flour and 25 parts of roasted Bengal gram flour and is fortified with essential minerals and vitamins A, D and B-Complex. One ounce of the product will supply the consumer with substantial quantities of proteins, minerals, fat soluble vitamins and riboflavin in which the diet of the average Indian is normally deficient. Rat growth studies (Subrahmanyam *et al*—unpublished) showed that the Indian Multi-Purpose Food at 12.5 per cent level has a marked supplementary value to poor vegetarian Indian diets based on wheat, rice, jowar and ragi and in this respect is comparable to the American Multipurpose Food based on soya grits. The same investigators did not find any significant difference between the protein efficiency ratios of mixed proteins of poor rice diets supplemented with 12.5 per cent Indian or American M.P.F.

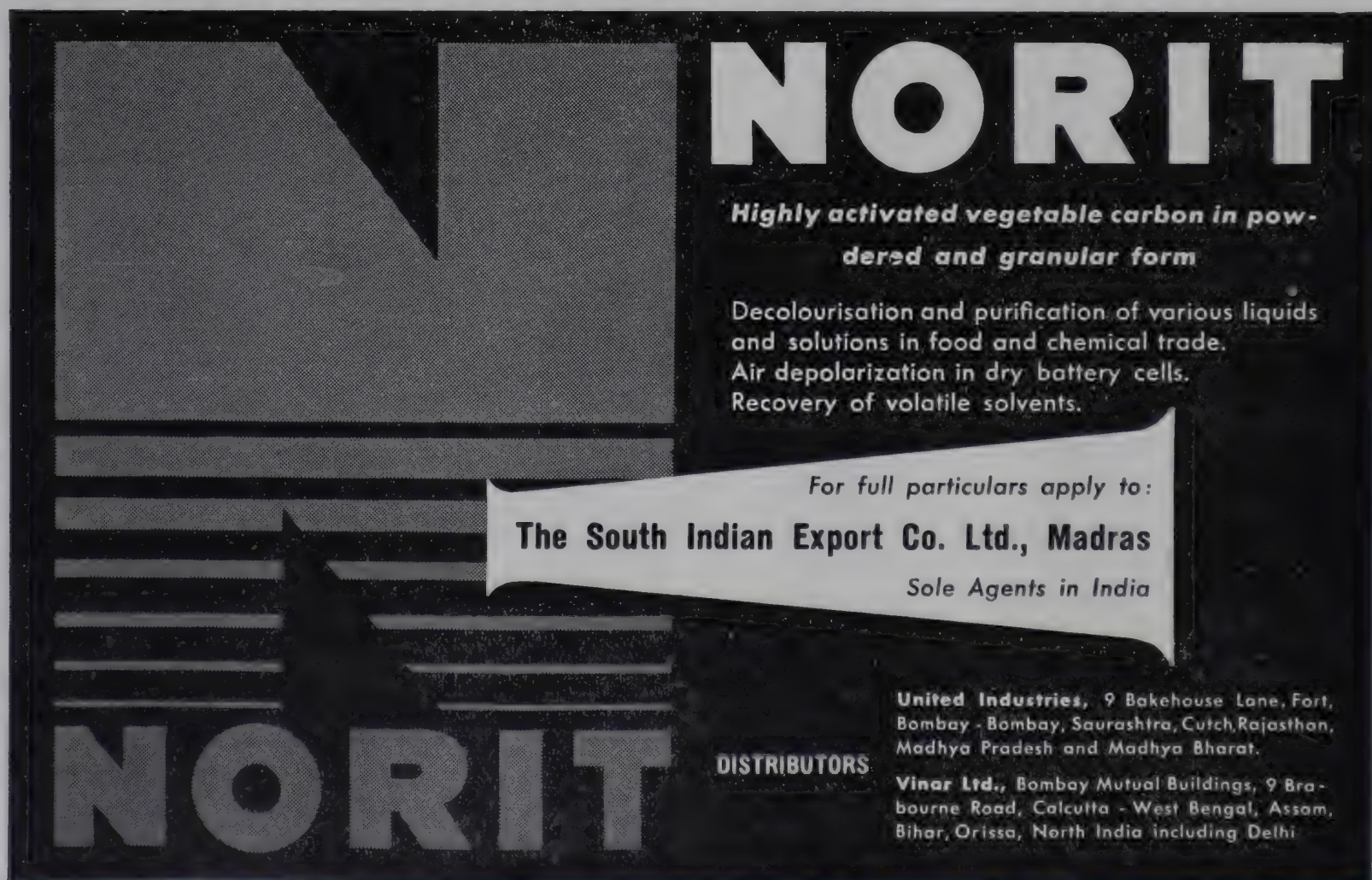
Biscuits: Recent investigations (Subrahmanyam *et al* unpublished) carried out in the Central Food Technological Research Institute, Mysore

have shown that low fat groundnut flour could be incorporated to the extent of 25 to 30 per cent in wheat biscuits fortified with vitamins and calcium. The protein content of the biscuits is thereby increased to about three to four times the original level (about 16-20 per cent as compared with 5 per cent in the unfortified wheat biscuit). About one ounce of the biscuits, fortified with groundnut flour, calcium, and vitamins, will form a good supplement to the diet of weaned infants and young children providing about 5-6 g. of protein, besides substantial amounts of calcium and vitamins.

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Technical Seminars

(Convener: A. N. SANKARAN)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during December 1956 are given below:

S (IS) 190 (137)

Chemical standards for Tea, by R. Venkateswara Rao, (December 8, 1956). At the outset, the speaker mentioned that at the request of The Tea Board, work was started in the Institute on the following aspects *viz.*, prescribing standards for genuine tea applicable to all varieties of manufactured tea produced in the country and evolving scientific techniques for the detection of adulteration of tea. The work of the Tea Research Unit was then presented.

A review of the existing specifications for tea showed appreciable variations and with a view to ensure uniformity, the Central Committee on Food Standards have recently prescribed a tentative standard drawn up on the basis of available data. No data is available on the variations occurring in the tea grown in different regions representing a wide range of climatic, topographical and management factors. With the co-operation of the scientific department of U.P.A.S.I. and Tocklai Experiment Station, samples of five grades of pekoes, small pekoes, Broken orange pekoe, Fanning, Dust I and Dust II were received every quarter from the estates in S. India and N.E. India selected on the basis of climate and geographical variations. The samples were analysed as per A.O.A.C. methods for the following: moisture, total ash, water soluble ash, and insoluble ash, alkalinity of soluble ash, nitrogen, petroleum ether extract, tannins, caffeine, sugars and water soluble extract. The averages based on 352 samples were presented on grade basis and discussed. The results of analysis of 30 samples of green tea were also reported.

In general, almost all black tea samples so far analysed fall within limits prescribed by the Food Adulteration Act. In some, higher values for crude fibre and acid insoluble ash were noticed. It is premature to comment on the regional and climatic variations in chemical composition but it was observed that samples manufactured during July showed a trend towards higher fibre content as compared with those manufactured in April. In green tea the tannin values were higher than those of black tea samples. The water soluble ash in almost all cases were over 50 per cent, the limit at present prescribed being 40 per cent. It would thus appear that the standard for water soluble ash needs revision. The need for differentiating the silica in tea leaf as separate from that contributed from extraneous sources was also pointed out.

The adulteration work has just been started. Values on the chemical composition of spent tea were then discussed.

Supplementing, Dr D.S. Bhatia outlined the genesis of the work and explained the need for collecting data on samples from different regions in the country to evaluate the inherent variations in chemical composition of genuine tea. Mr C. P. Natarajan stressed the need for standards on specific constituents in tea instead of stressing much on the ash values. He said that no standards have been fixed for caffeine and tannin, the two specific items in tea. It is also worthwhile considering whether it is necessary to have separate standards for black tea, green tea and stalky tea. He also pointed out the position regarding the crude fibre

estimation and its importance in the specification.

The President stressed the importance of incorporating in the specification, items which are more specific for tea like caffeine and tannins which will distinguish tea from other adulterants. He also mentioned about other teas which are sold in the market with different flavour like rose tea and said that separate standards should be prescribed for them.

S (IS) 191 (138)

Production of Active Dry Yeast, by Lewis, Y.S. and Dwarkanath, C.T. (December, 17, 1956). After explaining the function of yeast in Baker's dough as one of leavening it by production of carbondioxide, Mr Lewis said that the high gasing power of aerobically grown yeast in contrast with the poor baking properties of anaerobic yeast was due to the difference in the metabolic process involved. The aerobic growth stimulates production of more yeast and high enzymic concentrations.

Compressed yeast containing about 65 per cent moisture is being used for baking since 1860, but it is highly perishable and costly to transport. The need for making active dry yeast arose during the First World War and since then very large quantities of this product are being made in U.S.A., U.K., Europe and Australia. It is easy to transport and has a shelf-life of 6-12 months.

Although the idea of using spores of yeast to prepare active dry yeast seems attractive, it is not very practical since all the good industrial strains are illegitimate diploids which do not give viable spores; also the production of spores of

yeast on a large scale is very difficult. The present methods of manufacture of active dry yeast are held highly confidential, but broadly the method consists in producing compressed yeast, conditioning it, shredding and drying it at low temperatures, rapidly to a moisture content of 8-10 per cent.

Mr Lewis then outlined briefly the process evolved at the Institute. It involved growing a strain of Baker's yeast, *saccharomyces cerevisiae* Harsen-var *Ellipsoideus*, by stages in a nutrient solution made up of 4 per cent clarified molasses, 0.1 per cent urea or ammonium sulphate and 0.1 per cent potassium phosphate. Yields of about 3 lb. dry yeast per 15 pounds of molasses corresponding to 34 per cent yield on sugar were obtained. It was found necessary to avoid carefully metallic and microbial contamination and also to control the pH and temperature during growth. The drying had to be done at low temperatures in as short a time as possible. Negligence in any of the above resulted in serious losses of enzymic activity and viability of cells in the dried product.

He then presented analytical data on both commercial samples and those made at the Institute. A study of the values for moisture, trehalose, viability, iodine titre and baking strength show that the gasing power of active dry yeast depends, primarily on the viability of cells and to some extent on the trehalose content. The iodine titre indirectly represents the amount of extra-cellular glutathione in the sample. To some extent this indicates the degree of deterioration of the yeast. Lower temperatures of storage and packing the yeast in vacuum or inert gas slow down the metabolic processes and thereby increase considerably the shelf-life of yeast.

Concluding Mr Lewis said that the two factors which control the activity of active dry yeast are (1) initial enzymic activity and (2) ability of cells to increase in total enzymic concentration and that

further work is in progress to improve the product and to increase the shelf-life from 6 to at least 12 months.

Mr C. T. Dwarakanath outlined the procedures that were adopted for analysing the various samples of active dry yeast.

The discussion that followed covered points such as variation in trehalose content of the yeast during growing and drying, variation in the quality of different samples prepared in the laboratory, time and mode of cultivation of yeast and possibility of using methylene blue absorption as a measure of viability of yeast, etc.

The President in his concluding remarks said that the potential demand for baker's yeast in the country is large. He emphasised that contamination by undesirable metals should be avoided at all stages of production. He also suggested that the possibility of using yeast extract from other types of yeast may be considered.

S (IS) 192 (139)

Some Problems in Protein Enrichment of our Diets, by V. Subrahmanyam, (December 22, 1956).

Dr V. Subrahmanyam drew attention to certain problems that we have to face in connection with the protein enrichment of our diets. He pointed out that though the daily adult requirement of protein for the maintenance of normal health may be even less than 70g., the actual consumption in countries where people are known to be best developed and generally at a high level of health, is more than double the prescribed standard. Over a large part of our country, people will experience difficulty in consuming and digesting such a large quantity, even if they can afford it. We observed, quite a number of years ago, that not only children suffering from liver disorders, but even apparently healthy children have low gastric secretions of acid pepsin and rennin. Based on this observation, as also on the liver function tests, composition of stools and urine and blood composition, we had

postulated that hepatic cirrhosis in children has its origin, presumably in poor gastric and bile secretions. Unfortunately the treatment that we had given did not include any reduction in the protein and fat level of the diet and this may have had some bearing on our failure with advanced cases.

The low digestive secretions may have their origin in a low protein diet. The condition may be one of adaptation to such a condition and a sudden change to a richer diet may result in digestive disorders in such cases. A predominantly milk diet may be too rich for such a condition. Such an experience extends even to adults, for quite a number of us cannot digest milk except in very small quantities and that too in combination with some beverage or in some other diluted form. Apart from the difficulty in digesting the protein, there is the poor absorption of lactose which often leads to fermentation disorders.

We consume very few proteins in the relatively pure state. Most of them are associated with non-proteins, carbohydrates of different kinds, etc. As in the case of pulses, the latter often predominate and we have to consider their effect on the utilisation of proteins. Quite a number of them interfere with the digestion of proteins. In some cases, the utilisation is unaccountably low as may be instanced by the soyabean, which contains nearly twice as much protein as any of our commoner pulses but which ultimately has proved to be no better than any of the latter when consumed as a *dhal*. The protein of the same soyabean is easily digestible and shows a distinctly higher biological value when converted into milk. We have not yet got a satisfactory explanation for this phenomenon. Similar observations may apply, to varying extents, to other protein rich materials that we consume.

There is a further factor in the form of other food components that we consume. Even substances which are inert or innocuous may affect

the utilisation of proteins. Thus, we have observed that when mucilaginous substances are ingested as a part of our diet, they act mechanically and carry down large percentages of unabsorbed protein in the faeces. This is seen not only in the case of pure mucilages, but also in the case of different vegetables and even fruits like the bananas, when they are consumed above a certain level.

Apart from the above, there is the possible effect of intestinal fermentations on the utilisation of proteins. Such fermentations are largely influenced by the associated food materials. There is already the nucleus of fermenting organisms in the lower digestive tract. Some vegetables carry more of such infection and most of them leave fermentable residues. Our recent investigations have shown that vegetables like *Colacacia* cause enormous increase in putrefaction and gas-forming organisms in cecum. These, in turn, will also act on undigested proteins which are mechanically carried down. Another related factor is the function of spices and aromatics which, when taken at sufficiently high concentrations, have a controlling effect on the putrefactive organisms of the digestive tract. Our recent investigations have shown that both garlic and asafoetida have such an effect. The action is comparable, in many respects, to that of orally administrable antibiotics.

It will thus be seen that the subject of the utilization of proteins even after enrichment of the diet is more complicated than may first appear. Even the fats and oils that we consume as a part of our diet have a bearing on the utilization of proteins. Correspondingly, the proteins have an influence on the utilization of fat. Added to this, there is the complication that it will be extremely difficult for us to change our dietary patterns. Whatever improvements or modifications we make should fit in with the existing conditions and the economic levels of our people. As long as we are conscious of the

problems and can go on working at them from different angles, some positive improvements are bound to follow.

In the course of the discussion which followed, several important queries bearing on tolerance for proteins, the relation of *in vitro* to *in vivo* digestions, the effect of storage and desiccation of protein-rich materials in relation to their digestibility, the influence of spices on gastric secretions, fat in relation to cooking, interrelation between different dietary proteins, proteins in relation to longevity and resistance to infection, were raised. It was also pointed out that it is a well known fact in plant physiology that the level of nutrition has a relation to photosynthesis and utilization of nutrients by plants and that similar condition may also apply to higher animals including man.

S (IS) 193 (140)

Studies on Infestation Control in walnut, by Pingale, S. V. and Muthu, M., (*December, 29, 1956*)—Dr. Pingale, who spoke first, presented figures to show the importance of walnut in the export trade of dry fruits of India. He then described the type and extent of infestation noticed in the shells and kernels imported into U.K., on the basis of information received from the Food and Agriculture Ministry of that country. It was pointed out that though the walnut cases were fumigated in Bombay before being loaded in the ships, infestation was invariably observed at destination because no measures to protect the nut from insects in transit were adopted.

Mr. Muthu speaking next stated that walnuts were packed either at Jammu or in Delhi in specially made wooden cases that were lined with craft and butter paper. In his opinion the stores and the packing places were the sources of infestation. The process of fumigation carried out in Bombay was then described and it was pointed out that before the cases were shipped, it was made sure, by keep-

ing test insects, that all the insects present were killed by the fumigation.

Dr. Pingale, continuing further, discussed the suitability of various chemicals in the fumigation of walnut and showed that methyl bromide was the most suitable of the chemicals in use, because of its high toxicity to insects and of the relatively low residue. The industry, he pointed out, is using the chemical but in much higher concentration. Experiments carried out to determine the suitable concentration of the chemical were then described and it was reported that a dosage of 2 lb./1000 c. ft. for either 3 hours under a vacuum of 25" of mercury or 24 hours at atmospheric pressure was sufficient to effect complete mortalities in insects. These concentrations also left a residue that could be considered tolerable.

Trials undertaken with a view to protect the kernels subsequently from insect damage were then reported. It was observed that impregnation could protect the kernels from all but 2 insects and polyethylene bags of 300 and 500 gauge also offered protection from all but 2 insects. The insects penetrating through either the impregnated container or the polyethylene bags were different. Storage in 300 gauge polyethylene bag and using impregnated cases for keeping the polyethylene bag, proved satisfactory. He concluded by saying that commercial trials on these lines have been undertaken.

The discussions that followed covered points such as moisture pick-up on the shiphold during transit, fungal growth, rate of development of FFA, possibility of using a chemical with low vapour pressure, etc. The president in his concluding remarks drew attention to the crack developed in the shell of the nut which rendered it susceptible to the insect attack. He felt that preventing the development of the crack might offer a permanent solution to the problem.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Dehydration of Bananas

E(F) 11038 (324)

Kindly furnish the detailed data on the optimum humidity required for dehydrating 'whole' peeled bananas ('Pachabale' variety) and the ideal temperature and humidity conditions for storing the dehydrated product. Is it not worthwhile having an air-conditioned room for storing the dehydrated bananas? (Bombay)

No detailed data are available either with us or in literature to advise precisely on the optimum humidity conditions for dehydration of 'whole' peeled bananas of 'Pachabale' variety (used by you for dehydration) and the ideal temperature (in regions lower than room temperature) and humidity conditions for storing the dehydrated products. For the present we can, therefore, make only tentative suggestions based on our experience in this laboratory and on the information available in literature, with regard to some other varieties. These are as follows:

Dehydration:

R. Humidity in the beginning
= about 50%

R. Humidity towards the end
= about 20%

Storage:

Temperature 60-70°F

R. Humidity 60-70%

It may be, however, mentioned that in our experiments, the dehydrated product kept quite satisfactorily at R.T. (75-90°F) upto a storage period of about 8 months when it was properly dehydrated to a moisture content of about 15 per cent and packed in hermetically sealed containers. In these hermetically sealed containers, the

outside humidity will not have any effect on the product. Any slight discolouration which occurs at R.T. can be minimized by storing the product at low temperatures. The provision of an air conditioned room is, however, rather costly and will naturally add to the cost of the product. We shall like you to keep this in mind in relation to your production and maximum holding period in the factory, before going in for an air-conditioned room for storage of the dehydrated product.

Preparation of Pectin from Guavas

E(F) 11117 (325)

Let me know the method of preparing pectin from guavas. What type of fruit is best suited for the pectin extraction? (Saharanpur).

Guava is not rich in pectin. The fruit approaching ripeness contains only about 0.75 per cent pectin (about 5.0 per cent on dry weight basis), while at the perfectly raw stage it contains a little more. Some specific varieties, however, may have a somewhat higher pectin content. At present, we do not have data regarding different varieties. Besides this, the fruit contains a fair amount of sugars and other constituents which must be removed by thorough washing, before using the fruit for preparation of pectin; this will be rather difficult in this case. Unlike apples and oranges, the juice from this fruit cannot be expressed by pressing so as to get a residue containing the insoluble pectin and very little of sugars. Further, the fruit contains a fair amount of pectin in the soluble form, which increases with the ripening of the fruit. This will be

least during leaching and washing of the fruit. All these have to be taken into consideration. The price of fruit also is an important factor. So far as the method of preparation is concerned, the details standardized by us in the case of raw papaya, jack fruit wastes etc. are given below, and these may be employed in the case of guavas also.

The fruit is cut into thin slices or minced or grated. It is then washed to remove the soluble constituents, e.g., sugars, salts, etc. The washed fruit is then extracted in a medium of N/10 to N/50 HCl. Water of the fruit should also be taken into account for adding acid. Three half-hour extractions at 97-100°C are taken. The extracts are mixed and allowed to stand overnight for sedimentation after the addition of 0.1 per cent potassium metabisulphite. The clear extract is decanted and further clarified by centrifuging in a Sharples' Super Centrifuge. Sometimes, a second filtration may be necessary for good clarity, and may be carried out through a pad of paper pulp under pressure or suction. The clarified extract is concentrated under vacuum at 50°C and the pectin precipitated from the concentrate by the addition of 2 vols. of 95 per cent alcohol. Potassium metabisulphite is added to the extract at 0.5 per cent and HCl is added to the alcohol so that its concentration in the final mixture is 0.1N. The pectin precipitate is filtered the next day, washed with alcohol, dried, powdered and standardized.

The fruit is fairly satisfactory for the preparation of liquid pectin in the form of an extract of the fruit.

This, however, can be used only for the preparation of guava jelly during the 'off' season and not as a general purpose liquid pectin, because it will carry with it the predominant flavour of guavas. Such an extract may be prepared from the fruit approaching ripeness and without preliminary washing to remove the sugars, etc. Instead of HCl about 0.15 per cent citric acid may be used. The extract is separated and clarified as mentioned above. It may be further concentrated to some extent or used as such. It can be preserved satisfactorily with the addition of 300 p.p.m. of SO₂ added as potassium metabisulphite.

Potato Diseases

E (S) 11608 (326)

What are the diseases and defects common in potatoes and what steps should be taken before using such tubers for cold storage? (Farrukhabad).

The following disorders are found in potatoes: (1) a disease due to *Fusarium*, (2) a bacterial disease, (3) a physiological disease called 'blackheart', and (4) shrivelling. With regard to the first 2 diseases, rigid control should be exercised at the time of selecting the potatoes for cold storage to eliminate all diseased and bruised tubers. Further, before the storage of potatoes all the rooms and racks should be sprayed with a 5 per cent lysol solution. The third disease is due to exposure of potatoes to high temperatures before cold storage and improper aeration during cold storage. Attempts should be made to see that the potatoes are not exposed to unusually high temperatures before cold storage. A firm of refrigerating engineers may be consulted with regard to proper aeration of cold storage rooms. The fourth defect, namely, shrivelling, can be avoided by maintaining the relative humidity of the cold storage rooms between 85 to 90 per cent. A firm of refrigerating engineers may be consulted with regard to this point also.

Preservation of Pickles

E (F) 12803 (327)

Will you kindly suggest me the methods of preservation of various kinds of pickles? (Madras).

The methods of preserving pickles in brief are as follows:

1. *Pickles in Oil*: Pickles in oil do not spoil if they contain about 15 per cent common salt and the product is kept fairly well covered with oil.

2. *Pickles in Citrus Juice*: Pickles in citrus juice do not spoil if they contain about 15 per cent common salt and the acidity of the product is kept at a level of 3 per cent or above.

3. *Pickles in Brine*: Pickles in brine do not spoil if they contain 15 per cent or more of salt. The pickle should be kept well covered with common salt solution.

4. *Pickles in Vinegar*: Pickles in vinegar do not spoil if they contain at least 2 per cent acidity as acetic acid.

5. *Addition of preservatives*: According to amended F.P.O. 1955, the use of Benzoic acid in pickles as a preservative has been allowed. The maximum permitted dose of benzoic acid in pickles is 250 p.p.m. which is equivalent to about 299 p.p.m., of sodium benzoate.

Cold Storage Conditions for Oranges

E (S) 12805 (328)

Would you please furnish me the optimum conditions of temperature and relative humidity and the maximum storage life for oranges in cold storage? What is the post-storage life and will the quality of the fruit be affected under the above conditions? (Calcutta).

The data for different varieties of oranges are given below:

| Type of Orange | Storage Temp. and R.H. | Storage life (Approx) | Post-storage life (Approximate) at room Temperature |
|--|---------------------------|-----------------------|---|
| 1. Sathgudi ... | 42—45° F, R.H. 85—90 % | 4 months | 8 days |
| 2. Coorg mandarin, main crop ... | do | 2 months | 4 days |
| 3. Coorg mandarin, rainy season crop.. | do | 4 weeks | 2 days |

It is obvious from the above table that the post-storage life of oranges at room temperature may vary from 2-8 days depending on the type of orange, provided they have been stored for the maximum storage periods specified above. If short-term cold storage is resorted to, the post-storage life would be correspondingly longer. If consumed during the post-storage periods specified above the quality of the fruit is excellent and the oranges are in a fit condition to be consumed even by persons under medical treatment. After the completion of the post-storage lives, physiological breakdown and fungal infection may ensue rendering them unfit for human consumption.

Preparation of Tomato Soup

E (F) 13770 (329)

Kindly give me the details of the method of preparation of tomato soup. (New Delhi).

The method of preparation of tomato soup is given below:

Selection of material: Select fully ripe, deep red coloured tomatoes free from bruises. Wash them thoroughly to remove dirt, soil and other extraneous matter. Crush the tomatoes with a wooden laddle to facilitate easy extraction of the pulp. Heat the crushed mass to boiling and let it boil for 3-5 minutes. Strain it through 1 m.m. mesh sieve rubbing with the bottom of an enamelled cup to press out completely the pulp, and rejecting the seeds and skins.

Recipe: The following recipe has

been found satisfactory for the use in every 100 lbs. of juice.

| | |
|-----------------|--------|
| 1. Onion | 1 lb. |
| 2. Cinnamon | 8 g. |
| 3. Cloves | 8 g. |
| 4. Black pepper | 10 g. |
| 5. Red Chillies | 1 g. |
| 6. Cardamum | 3 g. |
| 7. Ginger | 7 g. |
| 8. Butter | 10 oz. |
| 9. Starch | 6½ oz. |
| 10. Sugar | 25 oz. |

Take required amount of starch and make paste with the addition of small amount of hot water. Add slowly more water while stirring it thoroughly and dilute it. Strain it with cloth. Keep it aside.

Now boil tomato juice with spices (mentioned in formula) tied up in a cloth bag. The starch solution prepared as described above is added in the tomato juice. When the brix of juice reaches 7°, sugar, salt and butter are added and boiled till the brix of the juice reaches to

10°. The soup is ready for packing in glass bottles or cans.

The crown cork bottles are pasteurized for 35 minutes; if it is packed in cans of Milk size it is pasteurized in boiling water for 40 minutes.

Cooling and storage: Remove bottles from boiling water. Let them cool and finally store in a cool, dry place. In case of tin containers they should be cooled under running tap water.

Notes and News

STATISTICAL NOTES

All-India Final Estimate of Potatoes, 1955-56

| | 1955-56 (Final Estimate.) | 1954-55 (Partially revised Estimate) |
|----------------------------|---------------------------------|---|
| Area (Thousand acres) | 693 | 658 |
| Production (Thousand tons) | 1,839 | 1,736 |

*(Economic and Statistical Adviser,
Ministry of Food and Agriculture,
Government of India)*

C.F.T.R.I. NEWS

Visitors

Shri S. Nijalingappa, Chief Minister of Mysore and Chairman of the Executive Council of the C.F.T.R.I.; Dr B. C. Guha, Prof. of Applied Chemistry, University College of Science and Technology, Calcutta; Dr A. Sreenivasan, Professor of Biochemistry, Dept. of Chemical Technology, University of Bombay and Dr A. N. Bose, Professor of Food Technology, College of Engineering and Technology, Jadavapur, visited the Institute on 2nd December 1956.

Dr S. Pradhan, Insect Toxicologist, Division of Entomology, Indian Agricultural Research Institute, New Delhi visited the Institute on 16th December 1956.

Tours

Mr G. L. Tandon accompanied by students of the Diploma Course in Fruit Technology, proceeded on tour to Bangalore, Nagpur, Mathura, Haldwani, Ramgarh, Barielly, Jullunder, Amritsar, Pathankot, Delhi and Bombay on 4-12-1956.

Dr V. Subrahmanyam proceeded on tour to Delhi on 11-12-1956 to attend the meeting of the Directors of the National Laboratories.

Drs V. Subrahmanyam, H. A. B. Parpia and K. V. Srinath proceeded on tour to Bangalore on 19-12-1956 in connection with the meetings of the Executive Council and Scientific Advisory Committee of the Institute.

Mr M. R. Chandrasekara proceeded on tour to Bombay and Anand on 21-12-1956 in connection with the preparation of Baby Food.

Dr S. V. Pingale proceeded on tour to Bangalore and then to Mangalore in connection with the studies on the storage of Coffee during monsoon months on the west coast.

Appointment

Mr C. S. Viraktamath has been appointed as Junior Scientific

Assistant in the Coffee Research Scheme.

Awards:

At the recent convention of the Oil Technologists' Association in India held on 30th October, 1956, the *Jaipuria Gold Medal* has been awarded to Mr Y. K. Raghunatha Rao and Mr R. G. Krishna Murthy for the research paper entitled 'Studies on a recent method of economic oil extraction from oil-seeds' adjudged to be the best out of the papers published in the Journal Vol. X (1954) of the Association.

The method refers to a 'process of alcoholic extraction of oil seeds' developed at the C.F.T.R.I., during the last three years and covered by Patent No. 46793 (1952). The method is specially applicable to the manufacture of Rice Bran Oil and Cottonseed oil in India which are expected to be of economic significance in the production plan for the next five year plan period.

List of Papers Published

561. **Discolouration in Rice: Its origin, Nature and Effect on nutritive value**, by Desikachar, H.S.R., Majumder, S.K., Pingale, S.V. and Subrahmanyam, V., *International Rice Commission*, 1956.

562. **Varietal Differences in the growth-promoting value of**

Rice, by Subrahmanyam, V., Kuppuswamy, S. and Swaminathan, M., *International Rice Commission*, 1956.

563. **Chemical methods of determining the degree of polishing in rice**, by Desikachar, H.S.R., *International Rice Commission*, 1956.

564. **Blackneck in Tomato ketchup**, by Bhatia, B.S., Siddappa, G.S. and Lal, G., *Res. and Ind.*, **1** (10), 212.

565. **Studies on Jelly making from papaya fruit**, by Lal, G. and Das, D.P., *Indian J. Hort.*, 1956, **13** (1), 38.

566. **Colorimetric determination of dehydrogenase activities of liver using Triphenyl tetrazolium bromide**, by Sreenivasamurthy, V. and Swaminathan, M., *Indian J. Physiol. all. Sci.*, 1955, **IX** (3), 107.

567. **Characterization of the pigment in red tamarind (*Tamarindus Indica*, Linn.)**, by Lewis, Y.S. and Johar, D.S., *Curr. Sci.*, 1956, **25** (10), 325.

568. **The comparative value of Soyabean and Bengal gram as supplements to the poor south Indian diet**, by Desikachar, H.S.R., Sankaran, A.N. and Subrahmanyam, V., *Indian J. med Res.*, 1956, **44** (4), 741.

569. **Effect of vitamin B₁₂ deficiency of Liver dehydrogenase activity in rats**, by Sreenivasamurthy, V., Desikachar, H.S.R. and Swaminathan, M., *Nature*, 1956, **177** (4512), 750.

570. **Determination of the degree of polishing in rice. IV. Percentage loss of phosphorus as an index of the degree of milling**, by Desikachar, H.S.R., *Cereal Chem.*, 1956, **33** (5), 320.

Additions to the Library

(Books Received under the Colombo Plan Aid)

1. *Dynamical character of adsorption*, 1953, by DE BOER, J.H., (Clarendon), pp. 239, £1-10-0.

2. *Britain's food supplies*, 1952, by FENELON, K.G., (Methuen), pp. 212, £0-15-0.

4. *Symposium on freezing and drying*, 1951, (Inst. of Biology, Lond.), pp. 205, £0-15-0.

5. *Comparative biochemistry of the carotenoids*, 1952, by GOODWIN, T.W., (Chapman and Hall), pp. 356, £2-10-0.

6. *Bile pigments*, 1953, by GRAY, C.H., (Methuen), pp. 142, £0-9-6.

7. *German cooking*, 1954, by HOWE, R., (Deutsch), pp. 223, £0-10-6.

8. *Modern applied photography*, 1953, by JONES, G.A., (Temple Pr.), pp. 162, £0-9-6.

9. *Strawberry cultivation*, 1953, by HYAMS, E., (Faber and Faber), pp. 162, £0-18-0.

10. *Nutrition and health*, 1953, by McCARRISON, R. and SINCLAIR, H.M., (Faber), pp. 125, £0-12-6.

11. *Text-book of practical botany*, 1952, by McLEAN, R.C., and COOK, W.R.I., (Longmans), pp. 476, £1-16-0.

12. *Microbial growth and its inhibition*, 1952, W.H.O. Series No. 10., pp. 285, £0-15-0.

INDIAN FOOD LAWS (*published in August 1954*) pp. v. + 220.

This volume summarizes all important details regarding the history, operation and enforcement of the food laws existing in different States in India, definitions, descriptions and chemical standards for articles of food including permissible additives, (colours, flavours and preservatives) and labelling of foodstuffs. The large number of tables on the comparative chemical standards prescribed for different food commodities in various parts of the country make the book useful for reference and guidance for the public analysts and the legal profession.

Price: Indian = Rs. 4-8-0 (*postage extra*); Foreign = 10 shillings

TECHNICAL AID TO FOOD INDUSTRIES (*published in July 1954*), pp. xvi + 270.

This publication contains the views and suggestions of prominent scientists, leading industrialists and food technologists, and Government officials on the nature of technical aid needed by different food industries in the country. Up-to-date technical and statistical data are provided and an appendix embodying the conclusions of the Symposium as well as a comprehensive index are given.

Price: Indian = Rs. 5-0-0 (*postage extra*); Foreign = 10 shillings.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

Paper chromatographic technique to detect organic acids in Citrus plant tissues (*Citrus Acida*), by Sekhara Varma, T.N. and Ramakrishnan, C.V., *Curr. Sci.*, 1956, **25** (12), 395.—A slightly modified method of Martin and Steel has been adopted to detect the organic acids present in different tissues of the citrus plant *viz.*, fruit at two stages of maturity, leaves, stems, root and flowers. Water extract of the tissues are prepared by digesting the material in a waring blender and measured quantities of the clear filtrate are used to run the chromatograms. Clear and well defined yellow spots without any tailing appears on a violet background. The presence of different organic acids in the extracts is detected by comparing the R_f values with the R_f values of the acids in the standard synthetic mixture whose chromatogram was also run. Citric, malic, fumaric and succinic acids are found to be present in the citrus plant tissues.

K.L.R.

Circular paper Chromatography. Part X. Separation, Identification and Quantitative Estimation of Riboflavin and Flavin compounds, by Giri, K.V. and Krishnaswamy, P.R., *J. Indian Inst. Sci.*, 1956, **38** (4), 232.—A method for the separation, identification and quantitative determination of riboflavin and its derivatives (flavin mononucleotide, flavin-adenine dinucleotide, lumiflavin and lumichrome) by circular paper chromatography is described. A number of solvent combinations have been tried in an attempt to obtain the best separation of the flavins, and n-butanol-acetic acid-water in the proportion 40:10:50

was found to give the best resolution both for qualitative characterisation as well as quantitative evaluation. Quantitative determination of the individual flavins was made by cutting out the bands from the chromatograms (after identification under ultra-violet light), eluting them with water and measuring the fluorescence in a fluorimeter. Spectrophotometric analysis was also carried out as a check-up and the recovery was found to be satisfactory. Some applications of the method for the study of riboflavin metabolism in a mutant yeast BY₂, are briefly described. The advantages and possible applications of the technique are discussed.

A comparative study of Junge's apparatus and an electrical apparatus for melting point determination as required in the performance of Phytosteryl Acetate Test on Ghee (Butter fat), by Dane, B.S. and Om Prakash, *J. and Proc. Oil Technol. Ass. India*, 1956, **12** (Part I), 29.—Junge's Melting Point apparatus is recommended for P.A. Test under Agmark Ghee Grading Rules. As this is cumbersome to use, an electrical apparatus manufactured by a well known firm was tried. Determination of melting points of 135 sterol acetate samples of ghee showed that results on both were not in close agreement. Results on devised apparatus were in closer agreement with Junge's. Hence it was concluded that Electrical apparatus was not sufficiently precise for this test. This was further confirmed. Certain defects and suggestions for improvement pointed out for Electrical apparatus are likely to make it more reliable.

(Bis-P-Dimethylaminophenyl-imide) as a reagent for the

characterisation of fatty acids, by Sukumar Das and Niyogi, S.G., *Ann. Biochem. exptl. Med.*, 1956, **16** (1), 5.—Bis-P-dimethylaminophenylimide has been used in an attempt to establish the identity of fatty acids. The reagent forms crystalline additive compounds with capric, oleic and linoleic acids. The melting point and the nitrogen content of the adducts have been determined and the values for nitrogen content are found to closely compare with the theoretical values. The method of preparation of the reagent i.e., di-imide starting with dimethyl-aniline has been described.

K.L.R.

BIOCHEMISTRY AND NUTRITION

A colorimetric method for the estimation of Cholinesterase activity in erythrocytes, by Sova Janah, *et al.*, *Ann. Biochem. exptl. Med.*, 1956, **16** (1), 17.—A colorimetric method for the study of cholinesterase activity of intact red blood cells has been described. A comparative study shows that human cells have the highest activity. Those from guineapig, rabbit and sheep have lower activity in the order stated. The enzyme activity seems to bear no relation with the haemoglobin content of the cells.

CEREALS

Alcohol acidity as a measure of soundness of Ata (whole meal flour), by Mitra, S.N. and Chatterji, R.K., *J. Indian chem. Soc. Industr. Edn.*, 1956, **18** (3), 139.—Earlier work had shown that the alcohol acidity of flour can be used to determine the spoilage in *ata* and to detect rancidity especially at the incipient stage of deterioration. The

AA have analysed several samples of sound and undamaged as well as deteriorated *ata* for the three acidities viz., water acidity, alcohol acidity and fat acidity. The alcohol acidity is determined by treating the sample with 90 per cent neutral alcohol for 24 hours (left overnight), filtering and titrating the filtrate with N/20 alkali. The results show that 220 mg. caustic potash per 100 g. of *ata* can be safely fixed as the maximum limit of alcohol acidity for sound and undamaged *ata*.

K.L.R.

Thiamine values of pure bred strains of some cereals and pulses, by Banerjee, S.N. and Guha, B.C., *Ann. Biochem. exptl. Med.*, 1956, **16** (1), 35.—Cereals and pulses lose much less of their nutrients during milling, washing and cooking than rice and hence when supplemented with the rice diet supply part of the thiamine requirement of the rice-eater. Analysis of different varieties of cereals, millets and pulses viz., wheat, jowar, Italian millet, red gram, green gram and black gram grown in different parts of India has been carried out for the thiamine values of the samples from two successive year's harvests. The thiamine values determined according to the method of Harries and Wang using a Lumetron fluorescence meter (Model 402 EF) are found to vary widely—those of wheat from 2.0 to 6.7, jowar 1.0 to 2.6, Italian millet 3.1 to 4.5, red gram 0.5 to 4.5, green gram 0.4 to 2.9 and black gram 1.3 to 3.0/ μ g. g. The thiamine content of the same strain of cereals and pulses obtained from two successive year's crops does not differ markedly with the exception of a few varieties of wheat and Italian millet. This indicates that the thiamine value is a stable characteristic of the variety in most cases.

K.L.R.

DAIRY PRODUCTS

Detection of Cane Sugar in milk and its products, by Mitra, S.N. and Roy, S.C., *J. Indian chem. Soc. Industr. Edn.*, 1955, **18**

(3), 168.—In adopting the resorcin—hydrochloric acid (Seliwanoff reagent) test for the detection of cane sugar in milk and its products, the time of heating and the concentration of HCl in the reagent have a great bearing on the intensity of red colour developed. It has been found that reconstituted milk prepared from milk powder and heated milk gave a distinct red colour when the test was performed using the Seliwanoff reagent prepared with 1:1 HCl, although they did not contain any cane sugar of levulose. On the other hand, there was a negative color test when 1:2 HCl was used in testing milk containing small amounts of cane sugar of the order of 0.5 per cent or below. The AA have determined the optimum concentration as 1:1.5 HCl at which level there was no colour with reconstituted milk and also presence of as little as 0.25 per cent of cane sugar could be detected. The optimum time of heating has been fixed as one minute. In the case of milk preserved in formalin and containing even appreciable amounts of sugar, the test fails due to the interference of formalin. To overcome this difficulty, the amount of resorcin was increased from 0.05 to 1.0 g. dissolved in 100 ml. of 1:1.5 HCl in the Seliwanoff reagent. This modified reagent is found to be helpful in detecting as little as 0.25 per cent cane sugar in milk preserved with or without formalin. The details of the final recommended procedure for detecting cane sugar in milk, milk powder and reconstituted milk are given.

K.L.R.

FISH

Studies on Fish flour, by Ramamurthi, K., *Ann. Biochem. exptl. Med.*, 1956, **16** (1), 9.—A comparative study of the nutritional value of fish flour with standard dietary (No.16) has been made through feeding trials on rats. Various compositions of diets with and without fish flour have been used. Animals fed a diet comprising of uncooked rice, fish

flour supplemented with enriched rice flour and cod liver oil showed good growth rate and this diet is definitely better than standard dietary (No. 16) made up of five-sixths of whole wheat and one-sixth of dried whole milk with table salt 2 per cent of the weight of the wheat and pure water. The fish flour diet was nutritionally almost equal to the control diet consisting of 16 parts of skim milk powder, 82 parts of enriched rice flour and 2 parts of cod liver oil.

K.L.R.

FRUIT AND VEGETABLE PRODUCTS

Vitamin C content of some fruits and vegetables of Darjeeling area, by Satya Ranjan Sarkar, *Bull. All India Inst. Hyg. and Pub. Health.* 1956, **3** (5), 15. —The ascorbic acid content of fruits and vegetables viz. churi (*Bessia Butyracea* Roxb), Granadilla (*Possiflora Edulis*), Naspatti or Peari (*Pyrus Communis* Linn), and Chillies (*Capsicum Annum* Linn) grown in places of high altitudes near about Darjeeling has been reported. No definite correlation is found between the vitamin C content of fruits and the altitude at which they grow. The vitamin content increases with maturity and ripening in all cases. The values for red chilies are higher than green chillies.

K.L.R.

Studies on the seed cake of *Annona Squamosa* (Sitaphal). Part I. The nitrogenous constituents of the seed cake, by Venkoba Rao, S., Ramachandran, K. and Zaheer, S.H., *J. Indian chem. Soc. Industr. Edn.*, 1955, **18** (3), 133.—The AA have analysed the defatted seed cake of *Annona squamosa* for its nitrogenous constituents. The seed cake contains 4.86 per cent nitrogen and 20.9 per cent of protein of which 63.5 per cent is water extractable. The non-protein nitrogen part of the water extract of the cake is made up of the fractions viz., 'Proteose N', Peptone N, simple peptides and bases N and residual N. The acid hydrolysate of the protein

isolated from seed cake consists of amide N, melanine, arginine, cystine, histidine, lysine and N in PTA filtrate. The papain-hydrolysate has also been analysed for the nitrogen fractions and it has been successfully used as an accessory nutrient in the fermentation of sugarcane molasses to lactic acid.

K.L.R.

Utility of the 'Albuminoid Ammonia' value in the analysis of food stuffs. Part II. Analysis of fruit juices, squashes and cordials, by Mitra, S.N., *J. Indian chem. Soc. Industr. Edn.*, 1955, **18** (3), 164.—The A has analysed several samples of fruit juices, squashes, cordials, crushes etc., and determined the values for albuminoid ammoniacal nitrogen (AAN) and total nitrogen. To counteract the reducing action of sugars present in these fruit products the method for the determination of AAN was modified by adding an excess of solid KMnO_4 in addition to the alkaline permanganate reagent in the second distillation. The figure for AAN is of great value in distinguishing synthetic from genuine products containing fruit juices because synthetic products which do not contain any natural fruit juice yielded no AAN. It is found that there is a broad relationship between the figures for total and albuminoid nitrogens, by which the total nitrogen and hence the total proteins can be calculated approximately from the AAN. For estimating the approximate protein contents of fruit juices, this AAN method which is far more simple and much less time-consuming than the long Kjeldhal method for total nitrogen can, therefore, be successfully used.

K.L.R.

Studies on the effect of canning and storage on the nutritive value of some common vegetables. Part III. Changes in ascorbic acid content of cauliflower, by Malakar, M.C. and Banerjee, S.N., *Ann. Biochem. exptl. Med.*, 1956, **16** (1), 29.—The

effect of canning and storage on the ascorbic acid content of cauliflower has been reported. It has been found in a few trials that blanching increases (varying from 0.4 to 19.4 per cent) the ascorbic acid content of the cauliflower. There is also an increase (varying from 1.6 to 16.7 per cent) in the ascorbic acid content of raw shredded samples kept at room temperature (19–30°C) for 3 hours. Autoclaving of the samples at 10 lb. for 20 min. destroys about 20 per cent ascorbic acid. The loss of ascorbic acid in the canned samples stored at a temperature varying between 15°C and 42°C has been determined at intervals over a period of 6 months. Results show that the loss is maximum during the first week (about 39 per cent, of which 20 per cent is due to autoclaving) and the total losses of the vitamin after storage for 15 days, 1, 2, 3 and 6 months amount to 51, 54, 59, 63 and 65 per cent respectively. The distribution of ascorbic acid in the solid and liquid portions of the can contents is found to be in the ratio of 1:3 throughout the storage period. Addition of solid ascorbic acid (100 mg.) to each can after blanching and before sealing the cans helps the product to retain a greater per cent of the vitamin during storage. The total losses of ascorbic acid in fortified samples after 7, 15 days, 1, 2, 3 and 6 months amount to 32, 35, 41, 49, 53 and 59 per cent respectively. The addition of extra vitamin also improves the colour and texture of the product and the brine is cleaner.

K.L.R.

MICROBIOLOGY

Effect of vitamin K_3 in inducing its biosynthesis in molds, by Ramakrishnan, C.V. and Vanamala Sathe, *Sci. & Cult.*, 1956, **22** (6), 340.—Earlier workers had isolated vitamin K from cultures of certain micro-organisms. In this note, the AA report the results of investigation on the synthesis of vitamin K_3 by molds. *Aspergillus flavus* isolated from

moldy groundnut seeds was subcultured twice in Czapek agar medium containing 2 μg . vitamin K_3 /10 ml. of the medium before use and then grown in another medium containing glucose, NaNO_3 , MgSO_4 , KCl and FeSO_4 and finally autoclaved. The vitamin K_3 content was determined by the spectrophotometric method in untreated and treated strains with different amounts of vitamin K_3 added to the medium. The results show that *Aspergillus flavus* does not synthesise vitamin K_3 unless it was previously subcultured twice in Czapek agar medium containing 0.2 μg ./ml. of vitamin K_3 . This indicates that the added vitamin K_3 induces the strain to synthesise more of the vitamin. It was also found that addition of 5 μg ., vitamin K_3 to the medium increases the synthesis whereas addition of 20 μg . suppresses the synthesis.

K.L.R.

The invertase activity of yeast in presence of acids and salts, by Biswas, M.M., *J. Indian chem. Soc.*, **33** (11), 815.—Invertase activity of brewer's yeast has been found to maintain a practically constant level in presence of constituent ions of different acids at the optimum pH (4.5). Activity of yeast invertase, purified by dialysis and precipitation with alcohol at the optimum pH, is appreciably influenced by different salts at the same pH (4.5).

OILS AND FATS

Pilot Plant for processing cottonseed at the Oil Technological Institute, Anantapur, by Murthi, K.S., *Indian Oilseeds J.*, 1956, **1** (1), 15.—Results of analysis of 260 samples of *Desi* type and 180 samples of American type cottonseed are presented in a table. The percentage of lint, oil, F.F.A. of oil in the seed, protein and size of the seed have been determined and the values compared with cottonseed produced in America. Storage studies have revealed that the oil content of the cottonseed does not alter over a storage period of one

year. The F.F.A., however, increases from 0.8 to 1.4 per cent in cold storage (38-42° F) and 0.8 to 1.8 per cent at room temperature (80-106° F) in one year. Pilot Plant trials on the processing of the two varieties of cottonseed have been carried out and the ranges in percentage yield of lint, hulls, meats, oil, cake and protein content of cake are given. These values are compared with those of cottonseed produced in America. Studies on the refining of the cottonseed oil on a pilot plant scale have shown that, by giving a preliminary treatment of degumming prior to alkali refining, the valuable by-product viz., Phosphatides to the extent of 0.6-2.4 per cent can be recovered. The refining losses can be reduced upto 20 per cent by using small quantities of chemicals (both electrolytes and non-electrolytes) during refining. It has been found that the dry method of refining gives better results than the wet method. Further work on finding out optimum processing conditions for milling and refining and their economics is in progress.

K.L.R.

Special Chemical Components of Sesame Oil, by Mittal, O.P., *Indian Oilseeds J.*, 1956, 1 (1), 38.—Sesame oil contains the following fatty acids: Myristic (trace), palmitic, 8.2; stearic, 3.6; arachidic 1.1; hexadecenoic, 0.5; oleic, 45.3; and linoleic, 41.2 per cent. Among the minor components present are phytosterol and two other components, viz., sesamin and sesamol which are present in the unsaponifiable fraction of the oil and which are not found in any other vegetable oil. Sesamol on hydrolysis gives sesamol. In this short review, the A deals in detail about the chemical composition and nature of carbon linkage in the structure of sesamin and sesamol belonging to the lignan group of

compounds also called as resinols. Presence of sesamol represents the first instance of the occurrence of a 4-hydroxy catechol methylene derivative in natural products and also it is the only lignan derivative with oxygen bridge. The synergistic action of sesame oil in insecticide mixtures is due to sesamin while the resistance of the oil to oxidative rancidity is attributed to the presence of small amounts of sesamol, i.e., 4-hydroxy catechol methylene ether. This antioxidant property is very much enhanced by hydrogenation which produces sesamol from the bound form, i.e., sesamol. Steam deodourisation of the hydrogenated oil destroys sesamol with the result the oil becomes less stable. Baudouin's red colour produced is by sesamol due to the formation of a triphenyl methane dye of the rosolic acid type.

K.L.R.

Effect of Metals and their Oxides on the Development of Rancidity in Sesame Oil, by Om Prakash, Sharma, T.R. and Amanullah Khan, *J. and Proc. Oil Technol. Ass. India*, 1956, 12 (Part I)

1.—The AA have investigated the effect of different metals and alloys viz., copper, iron, aluminium, tin, brass and stainless steel and metallic oxides, CuO, Fe₂O₃ and Al₂O₃ on the keeping quality of sesame oil kept in glass bottles for a period of 10 months. At periodical intervals, the oil samples are analysed for peroxide value, Kreis test, acid value, refractive index and organoleptic test for its odour and flavour. It has been found that CuO, Copper, Brass, Fe₂O₃ and iron have a definite pro-oxidative effect in decreasing order of effectiveness while aluminium, tin and Al₂O₃ have a slight antioxidant effect and stainless steel has no effect at all. The pro-oxidative effect of oxides is quicker than the

metals because of a larger surface being exposed to the action of the oil in the former case. The dissolution of the copper into the oil from copper metal and from CuO is maximum resulting in colouration of the oil. It is concluded from the results that greater the dissolution of the metal in oil, greater is the development of rancidity. The oil in contact with copper and brass kept fairly well for about 3 months, with iron for 3½ months, with stainless steel for 4 months and with tin and aluminium for about 4-5 months.

K.L.R.

Fatty Acids Composition of Fat from the Seed of Shorea-robusta, by Om Prakash, Gupta, A.C. and Rai, S., *J. and Proc. Oil Technol. Ass. India*, 1956, 12 (Part I), 47.—The fat from the seed of Shorea-robusta has been examined. The component fatty acids of the fat are found to be Palmitic 8.3 per cent, Stearic 34.7 per cent, Arachidic 12.3 per cent, Oleic 41.9 per cent and Linoleic 2.8 per cent. The composition of the fatty acids is somewhat similar to that of Cocoa-butter.

Urea Adducts of Fatty Acids, Part VI. Component Fatty Acids of Coconut Oil, by Mehta, T.N. and Kokatnur, M.G., *J. Indian chem. Soc. Industr. Edn.*, 1955, 18, (3), 158.—Decreasing solvent crystallisation method and urea adduct elution method have been applied to fractionate methyl esters of coconut oil fatty acids. An attempt has been made to build up the composition of fatty acids in the oil from the saponification equivalents and iodine values of the fractions. Due to the limitations of the effective application of urea fractionation technique to coconut and similar fats, it may be efficiently used to substitute the lead-salt-alcohol method suggested by Hilditch.

PART II (Foreign)

ANALYTICAL

Moisture Determination: Modified indirect conductivity method for determining water in cottonseed meal, by Hancock, C.K. and Burdick, R.L., *J. agric. Fd. Chem.*, 1956, 4 (9), 800.—Indirect conductivities and moisture were determined on 11 cottonseed meal samples (3.1 to 14.5 per cent water). The following values were obtained from a statistical analysis of the data: equation of regression line, per cent $H_2O = (73.4) (\text{millimhos}) - 22.1$; correlation co-efficient, 0.997; standard deviation from regression line, 0.27 per cent water. Replicate determinations were made on each of two samples (4.2 and 9.6 per cent water), for both samples the standard deviation was 0.20 per cent water. These results show that the accuracy and precision of the indirect conductivity method are satisfactory for practical applications. The time required per determination was about 9 minutes; it could be reduced to about 5 minutes by using duplicate sets of stirring apparatus.

Egg Proteins: Separation of Egg white proteins by paper electrophoresis, by Evans, R.J. and Bandemer, S.L., *J. agric. Fd. Chem.*, 1956, 4 (9), 802.—The need for a rapid method for the quantitative determination of the individual egg white proteins led to a study of their separation by paper electrophoresis. A procedure was developed whereby the proteins in whole egg white were separated by the ridgepole technique of Durrum, using a pH 8.6 diethylbarbiturate buffer of 0.05 ionic strength. The separated proteins were dyed with bromophenol blue, the colour was eluted with dilute sodium hydroxide solution, and absorbance was determined at 590 $m\mu$ in the spectrophotometer. Fresh egg white protein contained 65.2 per cent ovalbumin (48.4 per cent A_1 , 12.6 per cent A_2 and 4.2 per cent A_3), 11.2 per cent ovomucoid plus

ovoglobulin, 17.0 per cent conalbumin, 2.1 per cent non-mobile protein, and 4.5 per cent Lysozyme. The method is ideal for studying possible changes in egg white proteins during storage of shell eggs, because of its speed and the reproducibility of results.

BIOCHEMISTRY AND NUTRITION

Effect of drying conditions on the nutritive value of a processed stock diet for animals, by Harms, A.J. and Scott, P.P., *J. Sci. Fd. Agric.*, 1956, 7 (7), 477.—Tests carried out with weanling rats showed that a diet containing fish, whalemeat, meat and liver meal, biscuit waste and propyl gallate, dried in air at temperatures below 140° , supported good growth, whereas the same diet dried at 140° - 160° produced successively inferior growth. Rats given the diet dried at 160° were thin, lethargic and incapable of reproduction resembling rats maintained on a diet deficient in protein or in amino-acids rather than in vitamins. Chromatographic analysis did not indicate any destruction of essential amino acids, but the diet dried at 160° was more resistant to peptic digestion. It is suggested, and is supported by the findings of other workers, that the poor nutritional value of the diet dried at 140° and above was due to failure to digest the protein which had been damaged at this relatively low temperature by the formation of N-glycosides in the presence of reducing sugars.

Dietary energy requirements: Effects of caloric intake on nitrogen balance and organ composition of adult rats, by Rosenthal, H.L. and Allison, J.B., *J. agric. Fd. Chem.*, 1956, 4 (9), 792.—Restriction in caloric intake, with or without protein in the diet, resulted in depletion in body fat and body protein and an increase in body water in adult rats. The increase in water was particularly marked in rats fed a restricted

caloric intake in the presence of dietary casein. Nitrogen balance also decreased as calories were reduced, increased catabolic activity being a first response to such a restriction. The data were interpreted to mean that the animal could adapt to maintain essential tissues through shifts in metabolism, although continued deprivation in caloric intake resulted in marked loss in tissue nitrogen. There could be an optimum caloric intake for each protein intake. Differential changes of body tissues after caloric restriction demonstrated that some organs were more labile than others.

Amino acids and Kwashiorkor, by Hansen, J.D.L., *et al.*, *Lancet*, 1956, CCLXXI (6949), 911.—The AA have studied the effects of feeding synthetic amino-acids to children suffering from kwashiorkor due to protein malnutrition. It has been shown that mixtures of 18 or 11 amino-acids along with glucose, minerals and vitamins initiate cure i.e., within 10-21 days the skin lesions are healed or healing, the oedema has subsided completely and there has been a definite improvement in mentality and appetite of the children. There is also a rise in the serum-albumin level. These results are seen even in the absence of vitamins. In the first formula, the 18 amino acids constituted 59 per cent of the feed and in the other the 11 amino acids formed 16 per cent of the feed. The AA conclude that amino acids are the chief limiting nutrients of the diets, which help kwashiorkor to develop. The need for further work in order to determine the qualitative and quantitative aspects of amino acid requirements and imbalances in the cure and prevention of the disease has been stressed.

K.L.R.

CEREALS

Cereal product fortification: The B Vitamins, with special

reference to thiamine losses in baked products, by Coppock, J.B.M., *et al.*, *J. Sci. Fd. Agric.*, 1956, 7 (7), 457.—Certain aspects of cereal product enrichment with vitamins of the B group, especially thiamine, are discussed with particular reference to wheaten flour and rice. Losses of thiamine during the baking of bread and certain cakes and biscuits were found by the thiochrome method to be 17.3-23.3 per cent, 22.7-33.1 per cent and 26.0-29.7 per cent, respectively. During the toasting of bread, thiamine losses ranged from 13.4 to 31.0 per cent depending on the thickness of the slice. There was no indication that thiamine is destroyed during fermentation of bread dough. It is suggested that some degree of enrichment of existing National flour, in addition to that of low extraction flours, may be desirable in Great Britain.

Studies on the effects of treatment with chlorine dioxide on the properties of wheat flour. IV.—The biological properties of untreated, normally treated and over-treated flours, by Frazer, A.C., *et al.*, *J. Sci. Fd. Agric.*, 1956, 7 (7), 464.—Previous studies indicate that no significant nutritional damage to flour protein was incurred by the use of chlorine dioxide, even at ten times the normal level of treatment, and that no abnormal substances were formed. In confirmation of this previous work, further studies on animals have been made which form the subject of this report. The object of the experiment described in this paper was to apply classical group feeding experimental methods to the comparison of normally and ten times normally chlorine dioxide-treated flour. Since it was already known that no significant damage to known nutrients had occurred, the main emphasis was on the possible occurrence of any consistent differences indicative of toxic action. As a further check on this study, a group received the same flour untreated in Generations 0 and 1. All the

observations were also compared with standard figures obtained from a much larger group of animals not receiving chlorine dioxide-treated flour, but otherwise living under similar conditions.

The chemical estimation of vitamin E activity in cereal products IV. ϵ -Tocopherol, by Russell Eggitt, P.W. and Norris, F.W., *J. Sci. Fd. Agric.*, 1956, 7 (7), 493.— ϵ -Tocopherol has been isolated from wheat bran and some of its properties and its reactions have been studied. Its absorption spectrum, and that of nitroso- ϵ -tocopherol, are almost identical with the corresponding spectra for β -tocopherol. ϵ -Tocopherol, when oxidized with the Emmerie-Engel reagents, yields a tocopheroxide, which may be converted into the isomeric ϵ -tocopherylquinone. The latter shares a characteristically shaped absorption spectrum with β -tocopherylquinone. With nitric acid in ethanol, ϵ -tocopherol forms a red o-quinone and other products with a reaction spectrum again very like that for β -tocopherol. Only the β - and ϵ -homologues produce a brilliant violet unstable colour (not the quinone) with nitric acid in chloroform. In these reactions the new tocopherol behaves as if it is 5-methyltol and this structure is confirmed by the fact that ϵ -tocopherol yields 5:7-dimethyltol (ϵ -tocopherol) under conditions that convert β -tocopherol to α -tocopherol. Difficulties encountered in applying the Quaife nitrosation technique to the tocopherols are discussed. The factor converting depth of colour to concentration when ϵ -tocopherol is assayed by the modified Emmerie-Engel method described previously is 96.

FRUIT AND VEGETABLE PRODUCTS

Alpha-carotene in leaves of the carrot plant, by Booth, V.H., *J. Sci. Fd. Agric.*, 1956, 7 (6), 386.—About 13 per cent of the carotene in leaves of pigmented carrots was in the α -form. α -carotene was absent

from the leaves of all types of 'white' rooted carrots except second generation albinos, although the content of β -carotene was normal. α -carotene was present in cotyledons of those carrots which had, or would later have, any carotene (α or β) in their roots even at a stage too early for the roots yet to be coloured.

The characterization of phytin in peas, by Fowler, H.D., *J. Sci. Fd. Agric.*, 1956, 7 (6), 381.—Phytin has been extracted from peas by a method depending upon its insolubility in hot 8 per cent acetic acid. It has been characterized on the paper chromatogram and found to be a pure compound. Micro-analysis of this compound gives a carbon-phosphorus ratio compatible with that of a hexaphosphate. Comparison of pea phytin with commercial and synthetic calcium phytate (prepared by Posternak's method) using paper partition chromatography has shown that commercial phytin is composed of two organic phosphates (in addition to orthophosphate), one of which resembles pea phytin. The various compounds formed in addition to phytic acid in Posternak's synthesis have been examined and some have been tentatively identified.

Vitamins in Germination: Determination of free and combined inositol in germinating Oats, by Darbre, A. and Norris, F.W., *Biochem. J.*, 1956, 64 (3), 441.—The assay of inositol by *Schizosaccharomyces pombe* is used in a study of inositol in germinating oats. The organism is unaffected by fats, fatty acids and choline. Methods for assessing total and free inositol are described. Liberation of inositol from bound forms, chiefly phytin, by autolytic enzymes and by added phytase, are studied. During germination there is a net loss of inositol. A decrease in bound forms of inositol is compensated only partially by an increase in free inositol. Lipid inositol may be separated and assayed with some difficulty but is present only in small amount.

Estimation of α -Keto Acids in Plant Tissue: a critical study of various methods of extraction as applied to Strawberry leaves, Washed Potato Slices and Peas, by Isherwood, F.A. and Niavis, C.A., *Biochem. J.*, 1956, 64 (3), 549.—Various methods of inactivating the enzymes in strawberry leaves, in washed potato slices and in peas have been critically compared as a preliminary to the estimation of the α -keto acids by the chromatographic method of Isherwood and Cruickshank (1954). The results showed that the use of hot acid or strongly alkaline media, or boiling methanol, led to both the formation and destruction of α -keto acids by chemical reactions occurring in the tissue extract during disintegration. Any method of heat inactivation was open to the suspicion that the enzymes were not inactivated sufficiently rapidly to avoid a brief period of heat stimulation, thus causing a significant change in the α -keto acids in the tissue. In the recommended method, the tissue was frozen in a mixture of methanol and solid carbon dioxide and then disintegrated in 0.6M metaphosphoric acid at -2° . The principle of this procedure, that it is best to arrest the activity of the enzymes by cooling to a low temperature and inactivate them by chemical treatment while they are still in this arrested state, is important in the estimation of other labile intermediates such as phosphoric esters.

Role of pH in the canning of Jack fruit (*Artocarpus integrifolia*): Effect of adding acid or other fruits to the canned product, by Bhatia, B.S., *et al.*, *J. Sci. Fd. Agric.*, 1956, 7 (8), 531.—Jack fruit has a high pH value of 5.0 to 5.8 and therefore has to be processed under pressure unless the pH of the canned product is brought below 4.5. Addition of 0.75 to 1.0 per cent citric acid to the canning syrup has been found to be necessary to bring the pH of the canned jack fruit below pH 4.5 thus making it safe for processing in boiling water for 30 minutes.

This object has also been found possible to be achieved by canning the fruit in combination with more acid fruits like some varieties of mangoes or pineapple.

S.R.

Rapid colorimetric methods for simultaneous determination of total reducing Sugars and Fructose in Citrus juices, by Ting, S.V., *J. agric. Fd. Chem.*, 1956, 4 (3), 263.—A rapid colorimetric method for the estimation of glucose and fructose in presence of each other in fruit juices, has been given. Ferricyanide is used in a carbonate-phosphate buffer as the oxidising agent for sugars. The resulting ferrocyanide is measured colorimetrically after the addition of Nelson's arsenomolybdate reagent, in a photometer using a green filter (515 m μ). When heated at 100°C for 10 minutes, glucose and fructose are oxidised in equal amounts. When heated at 55°C for 30 minutes, all the fructose, but only 1/8 to 1/9 of the glucose, is oxidised. The quantities are calculated from a previously calibrated curve with known mixture of fructose and glucose heated at 55°C for 30 minutes. Sucrose can also be estimated in the same way after cold inversion. Clarification of the juice samples with neutral lead acetate had no interference in the determination.

G.V.K.

INSECTICIDES

Mode of action of pesticides: Metabolism of organophosphorus insecticides in relation to their antiesterase activity, stability and residual properties, by Casida, J.E., *J. agric. Fd. Chem.*, 1956, 4 (9), 772.—Organophosphates are biologically active, because they inhibit enzyme action through formation of inactive phosphoryl esterases. Stable phosphate precursors are in many cases converted within the organism to reactive antiesterases. Certain but not all di-methylphosphoramides and phosphorothioates require *in vivo* oxidation to effect their anties-

terase action. Other biochemical reactions either increase or decrease the organo-phosphate antiesterase activity. The stability of the phosphoryl esterase is very important; if this complex is unstable, the enzyme may serve in detoxification, whereas if a phosphoryl cholinesterase is very stable *in vivo*, a definite chronic toxicity problem may result. A good organophosphate insecticide requires a suitable balance of group specificity, antiesterase activity, and stability the balance varying with each new economic use for an antiesterase agent.

MICROBIOLOGY

Morphological and physiological groups of soil bacteria from the roots of barley and oats, by King, H. D. and Wallace, R. H., *Canad. J. Microbiol.*, 1956, 2 (5), 473.—Morphological and physiological characteristics were studied of more than 2400 stock-cultures of bacteria isolated from rhizosphere soils of barley and oats, and from control soils. Gram-positive rods were proportionately more numerous in control soils than in rhizosphere soils; this difference was greater with oats than with barley. The proportion of Gram-negative rods was greater in rhizosphere soils than in controls but not more so for one crop than the other. Gram-positive rods replaced a significant portion of Gram-negative rods in soils of the mature barley plants. The only significant increase in percentage incidence of physiological groups in rhizosphere soils was in regard to nitrate-reducing bacteria of the young oat plants. On the other hand there were significantly smaller percentages for starch hydrolyzing bacteria and gelatin liquefiers in oats rhizospheres than in the controls. There were not any significant differences between rhizospheres and controls with regard to physiological groups from the barley plants. It is concluded that the proportional incidences of some physiological groups of soil bacteria are not greatly increased,

but in some instances are decreased, by the presence of barley or oat roots growing in Chicot sandy loam.

Secretion of nicotinic acid by biotin-dependent yeasts, by Rose, A.H. and Nickerson, W.J., *J. Bact.*, 1956, **72** (3), 324.—The effect of biotin on nicotinic acid secretion by each of eight yeasts was investigated; in all but two of these yeasts positive evidence was obtained for a link between the requirement for biotin and retention of nicotinic acid. Examination of the effect of aspartic acid on nicotinic acid secretion by *Saccharomyces cerevisiae* indicated that the asparatate-stimulation of growth observed at suboptimal concentrations of biotin is not associated with nicotinic acid secretion.

Effect of polymyxin B on bacteria isolated from pitching yeast and spoiled beer, by Morris, E.D. and Brady, B.L., *J. Inst. Brew.*, 1956, **62** (5), 406.—Earlier workers had reported the possibility of using polymyxin B sulphate for controlling gram-negative bacteria in the brewing process. From trials conducted in this line, the AA have found that the antibiotic is very effective in completely suppressing the infection of pitching yeast due to *Flavobacterium proteus* but infection due to other gram-negative rods like *Lactobacillus* and *Acetobacter* are only partially suppressed due to the resistance of these bacteria against the antibiotic. In any attempt to control specific infection, the necessity of prior assessment of the degree of sensitivity of the bacteria towards polymyxin B has, therefore, been stressed.

K.L.R.

Control of bacterial infection by Bacitracin and Neomycin: A preliminary note, by Morris, E.O., *J. Inst. Brew.*, 1956, **62** (5), 412.—The efficiency of using two antibiotics, bacitracin and neomycin in controlling bacterial infection in fermenting brewery wort has been studied. Addition of 20 p.p.m. of neomycin or 80 p.p.m. of bacitracin completely inhibits

the growth of *Lactobacillus* infecting pitching yeasts. In the case of *Acetobacter*, however, the concentrations of the antibiotics required to control the infection being very high, their large-scale use would have to be excluded from the practical point of view.

K.L.R.

Carbohydrate metabolism in citric acid fermentation. 5. Purification and properties of Zwischenferment from *Aspergillus Niger*, by Jagannathan, V., *Biochem. J.*, 1956, **64** (3), 477.—Zwischenferment from *Aspergillus niger* was purified about 60 fold. The purified enzyme was free from phospho-glucosomerase, phosphoglucomutase, hexokinase and 6-phosphogluconic dehydrogenase, and was suitable for analytical purposes. Some of the properties of the enzyme, pH optimum, Michaelis constant, etc., have been described.

A survey of the number and types of aerobic mesophilic spores in milk before and after commercial sterilization, by Franklin, J.G., *et al.*, *J. appl. Bact.*, 1956, **19** (1), 46.—Milk, before and after commercial sterilization, supplied by ten different sterilizing depots, was examined over a period of 18 months to determine the aerobic mesophilic spore content. The numbers present in raw bulk tanker milk exhibited a seasonal variation, the counts being higher in winter than in summer. This was not found in sterilized milk. Spore counts in raw milk ranged from 0-700/100 ml. and in sterilized milk, with one exception, from 0-1.1/100 ml. During the last 12 months of the experiment, the types of aerobic mesophilic spore forming organisms causing spoilage were isolated and identified, using a simplified method of identification. Eight different species were isolated from raw milk and seven from sterilized milk. The incidence of the different types in raw milk was: *B. licheniformis*, 62 per cent; *B. brevis*, 15 per cent; *B. subtilis*, 7 per cent; others, 9 per cent and unidentified, 7 per cent.

In sterilized milk this was: *B. subtilis*, 44 per cent; *B. Licheniformis*, 26 per cent; others, 17 per cent and unidentified, 13 per cent. There was no apparent seasonal variation in types.

The rates of growth of some thermoduric bacteria in pure culture and their effects on tests for the keeping quality of milk, by Williams, D.J., *J. appl. Bact.*, 1956, **19** (1), 80.—The growth rates of eleven representative thermoduric bacteria, comprising 3 aerobic spore formers, 3 streptococci, 1 *Corynebacterium lacticum* and 4 micrococci, have been determined in glucose broth and sterile pasteurized milk at 37.5°, 26° and 15°. The spore formers and streptococci were generally not affected by the presence of inhibitory factors in pasteurized milk. When multiplication of micrococci and *C. lacticum* occurred in milk this was only after a lag period. One micrococcus showed an unusual series of growth phases in glucose broth at 37.5°, possibly due to the appearance of mutants or to adaptation of the organism to growth at that temperature. This was not observed in pasteurized milk. *C. lacticum* died off when incubated in glucose broth at 37.5°. None of the keeping quality tests were more effective than any other in detecting these organisms in milk. The micrococci and *C. lacticum* had little effect on the keeping quality of pasteurized milk within the period of 'commercial life'. Some of the spore formers and streptococci showed marked differences in the end-points with the clot-on-boiling and the alcohol precipitation tests.

The use of a selective medium for the enumeration of lactobacilli in cheddar cheese, by Marbitt, L.A. and Zielinska, M., *J. appl. Bact.*, 1956, **19** (1), 95.—The use of a selective solid medium for counting lactobacilli in Cheddar cheese is described. It has proved useful for this purpose, especially in the early period of ripening when large numbers of streptococci render other methods impracticable. The medium, in a semi-solid form, is

more sensitive for the detection of heterofermentation in lactobacilli than media previously available. The possibility of using it to count heterofermentative lactobacilli and leuconostocs is discussed.

OILS AND FATS

The crystallization of cocoa butter and alternative fats. II—Palm kernel stearins and their mixtures with cocoa butter and butter fat, by Steiner, E.H., *J. Sci. Fd. Agric.*, 1956, 7 (6), 425.—The results are presented of calorimetric and cooling curve measurements on eight palm kernel stearins. Consideration is given to phase composition and crystallization of the stearins alone and in admixture with cocoa butter and butter fat in binary and ternary mixtures. The practical implications of the results

are discussed in regard to the use of the stearins as alternatives to part of the cocoa butter in chocolate.

GENERAL

Canned Food, by *Brit. med. J.*, 1956, 879.—The report gives the highlights of the III International Conference on Canned Foods held in Rome from September 24th to 28th. Some of the practical difficulties in ascertaining the absence of harmful bacteria by examination of batches of cans were stressed by some speakers. 'The only really satisfactory solution was to rely on a canning process which would ensure the killing of all unwanted microbes in the product. This should be coupled with prevention of their re-entry by strict attention and the integrity of can seams and the use of sterilized cooling water'.

Acidity below pH 4.5 inhibited *cl. botulinum*. Hence in fruit products the danger was found to be much less than in meat products. This had to be taken into consideration when deciding on the number of cans to be examined. Plant sanitation and problems of designing equipment for sanitary processing of food products were also considered.

The search for antibiotics which would be of value in canning was still in progress, and one of the speakers felt that antibiotics caused damage to the mucose of the tongue and the stomach.

The undesirability of using chemicals as preservatives and the difficulty of identifying them were also stressed by several of the speakers.

M.R.C.

LIST OF ABSTRACTORS

G. V. K. = G. V. KRISHNAMURTHY

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S. R. = S. RANGANNA

BROCHURE ON HOME-SCALE FOOD PREPARATIONS SERIES

This brochure contains 60 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, *viz.*, the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 52 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products.

Price: Re 1-0-0 (*postage extra*)

EFFECT OF ASAFOETIDA ON THE INTESTINAL (WALL) ENZYME SYSTEMS IN VITRO

By M. V. PATWARDHAN and L. V. L. SASTRY

(Central Food Technological Research Institute, Mysore)

In continuation of our previous investigations on asafetida¹ we have now attempted to study its action on various enzyme systems of the intestinal wall. Among the various therapeutic properties ascribed to asafetida are its antispasmodic, laxative, diuretic and carminative effects, the last one being the most pronounced. But a literature survey has not revealed any published data on these biochemical or pharmacological effects of this drug. Bhat and co-workers² observed that in some typical gas forming organisms of *Coli aerogens* group, asafetida altered the ratio of hydrogen and carbon dioxide producing more of hydrogen.

Materials and Methods

The enzyme source was the intestinal wall of the rat. The animals were killed by stunning and the length of the small intestine was removed. It was washed with cold distilled water after splitting open and then homogenised in phosphate buffer (0.1M, pH 7.4) or distilled water. The homogenate was centrifuged at low speed for a

minute to remove the debris and the supernatant solution was dialysed for three hours. All the operations were carried out at 4°C and the following enzyme systems were studied:

TABLE I. Effect of Asafetida on Intestinal (Wall) Enzymes

| Enzyme System | Substrate | Asafetida concentration γ per ml. | | | |
|-------------------|--|--------------------------------------|-----|-----|------|
| | | Nil | 100 | 300 | 1000 |
| 1. Dehydrogenases | Endogenous (Methylene blue acceptor) | 600 | ... | 700 | 670 |
| 2. Dehydrogenases | Endogenous (Triphenyl-tetrazolium chloride acceptor) | ... | 135 | Nil | Nil |
| 3. Esterase | Ethyl butyrate | 104 | 40 | 40 | 40 |
| 4. Peptidase | L-alanylglycine | 190 | 250 | 240 | 240 |

ENZYME UNITS

1. mg. methylene blue reduced by 1 g. intestine per hour at 37° C.
2. mg. TTCI reduced by 1 g. intestine per hr. at 37° C.
3. ccs. 1.0 N NaOH required to neutralise acid liberated by 1 g. intestine; incubation time, 17 hours at 37° C.
4. γ glycine liberated by 1 g. intestine per hour at 40°C.

Dehydrogenases: The dehydrogenase activity was measured by Thunderg's method as modified by Tulpule and Patwardhan³, using methylene blue as acceptor. In other experiments triphenyl tetrazolium chloride was used as the acceptor⁴. Butyrate, glutamate, lactate, and succinate were used as substrates and boiled muscle extract (BME) as the source of DPN.

Esterases: Method of Cherry and Crandall⁵ was used, ethyl butyrate being the substrate.

Peptidase: Intestinal peptidase activity was followed by measuring quantitatively the amount of glycine released from L-alanylglycine. Butanol: acetic acid: water (4:1:1) was used to develop the chromatograms.

Phosphatases: Alkaline and acid phosphatase, pyrophosphatase, hexose-1-6-diphosphatase, and

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glucose-6-phosphatase activities were studied by estimating the liberation of inorganic phosphorus from various substrates. Phosphorus was estimated by the method of Fiske and Subbarow⁶.

Invertase: Only in this case a B.D.H. preparation was used.

Assay: Asafoetida, of known concentration, in the form of an aqueous suspension was first added to the buffered reaction mixture containing the homogenate and incubated for five minutes. Then the substrate was added and the reaction continued under optimum conditions for stated intervals. Final concentration of asafoetida in the tubes varied from 30 γ /cc. to 1 mg./cc. in the various cases.

Results and Discussion

Under the present experimental conditions no significant effect of asafoetida on the activities of various enzyme systems could be noticed.

Succinic dehydrogenase activity was unaffected by asafoetida. The endogenous dehydrogenase activity in presence of BME, however, showed a slight increase when methylene blue was used as an acceptor. On the other hand, when triphenyl tetrazolium chloride dye was used, the endogenous activity showed a decrease. As the changes were not very significant under our experimental conditions no attempts were made to investigate further the types of dehydrogenases so affected.

Various phosphatases studied did not show any changes at all under the influence of asafoetida. Esterase activity was slightly depressed while

invertase was unaffected. Peptidase activity using alanyl glycine as substrate showed a slight increase in activity even when concentrations as low as 30 γ /ml. of asafoetida were employed in the reaction mixture.

On the whole, the enzymatic pattern of the intestinal wall studied under the present conditions did not show any significant differences in the presence of asafoetida *in vitro*. Whether the minor changes noticed above may have any influence on the final action of the compound *in vivo* is difficult to judge from the present observations.

Whereas Wills⁷ reported that the active principle of garlic, *viz.*, allicin, inhibited nearly all the sulphydryl enzymes but few non-sulphydryl enzymes, our observations with asafoetida recorded here are not similar.

The authors' thanks are due to Dr M. Srinivasan, Assistant Director, for his helpful guidance and criticism and to Dr V. Subrahmanyam, Director, for his kind interest during the course of this investigation.

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This brochure contains 66 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, *viz.*, the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 55 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation; 'Indian Sweet Series' giving methods of preparation and preservation of 3 kinds of typical Indian sweets; and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products.

Price: Re 1-0-0 (postage extra)

NUTRITIVE VALUE OF THE LEAVES OF SAUROPUS ANDROGYNUS (L)

Merr (Chakur Manis)

By M. N. SATYANARAYANA AND G. RAMA RAO

(Central Food Technological Research Institute, Mysore)

The leaves of this vegetable plant which is new to India but reported to be a common and popular vegetable cultivated throughout Java are eaten either raw or after steaming. The Madras Agricultural Department has introduced this plant from Borneo for experimental cultivation at the Agricultural College Farm, Coimbatore and at the Agricultural Research Stations, Pattambi and Mangalore. At the instance of the Madras Agricultural Department, the Indian Council of Agricultural Research wanted the Central Food Technological Research Institute, Mysore, and the Nutritional Laboratories, Coonoor, to analyse these leaves with a view to assessing their nutritive value.

A sample of the oven-dried material was received through the courtesy of the Horticulturist and Professor of Horticulture, Agricultural College, Coimbatore. The material was finely powdered and passed through 80 mesh sieve. It was analysed for proximate principles according to the methods of A.O.A.C.¹. Thiamin was determined by the method of Swaminathan², riboflavin by microbiological assay³, total sulphur according to the method of Evans⁴ and inorganic sulphur according to the method of Evans and St John⁵, and non-protein nitrogen in the filtrate after treatment with 10 per cent trichloroacetic acid. These values are given in Table I. Vitamin C will be estimated in fresh leaves.

TABLE I

per cent

| | | |
|-------------------------|-----|---------|
| Moisture | ... | 4.1 g. |
| Total Ash | ... | 15.4 g. |
| Acid Insoluble ash | ... | 1.5 g. |
| Fat (Ether extractives) | ... | 7.5 g. |
| Protein (N × 6.25) | ... | 26.0 g. |
| Crude fibre | ... | 2.3 g. |
| Carbohydrate (by diff.) | ... | 44.8 g. |
| Calcium | ... | 120 mg. |
| Phosphorus | ... | 17 mg. |
| Thiamin | ... | 0.1 mg. |
| Riboflavin | ... | 1.0 mg. |
| Total Sulphur | ... | 0.45 g. |
| Inorganic sulphur | ... | 0.25 g. |
| Non-protein nitrogen | ... | 1.8 g. |

The total amino acid composition of the proteins of the leaves was determined by paper chromatographic procedures^{6,7} after acid hydrolysis (Table II). The values for cystine and methionine determined by the differential oxidation procedure^{4,5} are also included. Combined values for (lysine hydrochloride and histidine) and (leucine and iso-leucine) are given. Tryptophan and proline have yet to be determined.

TABLE II. Amino acid composition of the proteins of Chakur manis

(Values expressed as g. per 16 g. Nitrogen)

| | | |
|----------------|-----|--------------|
| Alanine | ... | 5.40 |
| Arginine | ... | 5.76 |
| Aspartic acid | ... | 10.23 |
| Cystine | ... | 1.01 (1.89*) |
| Glutamic acid | ... | 11.84 |
| Glycine | ... | 3.4 |
| Histidine | } | ... |
| Lysine HCl | | |
| Iso-leucine | } | ... |
| Leucine | | |
| Methionine | ... | 1.15 (1.34*) |
| Phenyl alanine | ... | 4.96 |
| Serine | ... | 3.93 |
| Threonine | ... | 5.93 |
| Tyrosine | ... | 5.33 |
| Valine | ... | 3.69 |
| Total | | 79.45 |

* Determined by chemical methods

Assessment of the biological value and protein efficiency ratio will be carried out when requisite quantities of the material now asked for from Coimbatore are made available.

The authors' thanks are due to Dr V. Subrahmanyam and Dr M. Srinivasan for their kind interest in the investigation and to Mr B. K. Keshava for the microbiological assay of riboflavin.

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CHANGES EFFECTED BY INSECT INFESTATION IN GROUNDNUT KERNELS

India is a major groundnut producing country and large quantities of the produce are stored as kernels between two harvests of the crop. Quantitative losses caused by insects during the storage of groundnut are reported by Arant¹ and the Indian Central Oil Seeds Committee². An account of the changes resulting from insect attack is given in the present note.

Materials and Methods

Groundnut grown around Mysore was obtained two months after the harvest, shelled and only the sound kernels were stored in jute bags of 5 lb. capacity. Bags were placed in insect-proof cabinet (temp. 78-85°F and 52-58 per cent R.H.) Twenty, 2-day old larvae of *Corcyra cephalonica* St. and 10 couples of *Necrobia rufipes* F., *Oryzaephilus surinamensis* L., and *Tribolium castaneum* Hub., were released in separate cabinets.

Viability and chemical estimations were carried out according to the standard methods previously adopted by Pingale *et al.*³. Thiamin was determined on the defatted samples. Samples infested by *C. cephalonica* were examined at intervals of 2 months whereas the other samples were analysed only at the end of six months.

Results and Discussions

The results are shown in Tables I and II. The hygienic condition deteriorated in all insect infested kernels with progressive insect activity. Beetles only bored the kernels but *C. cephalonica* larvae besides boring, covered the kernels with webbings and discoloured them. The significant finding was that though, any insect damaged kernels were considered unacceptable for consumption, effects of insect infestation could be detected by the judges in cleaned ground material only when the proportion of damaged kernels exceeded 10 per cent. Further, the oil obtained from kernels containing 20 per cent damaged kernels was turbid and contained insect fragments. Insect damage also affected the yield of oil. Similar effect on the yield of oil is reported by Kasargode and Deshpande⁴ and Hall⁵ in respect of groundnut pods damaged by insects.

TABLE I. Effect of *C. cephalonica* Infestation on Groundnut Kernels

| Particulars | Initial | Values after storage for | | |
|--|---------|--------------------------|----------|----------|
| | | 2 months | 4 months | 6 months |
| Total Nitrogen% ... | 4.03 | 4.06 | 4.12 | 4.20 |
| Fat% ... | 49.6 | 48.0 | 47.0 | 46.0 |
| Thiamin $\mu\text{g/g}$ * ... | 10.8 | 10.25 | 9.00 | 7.40 |
| Acidity of fat expressed as% oleic acid. | 0.87 | 0.99 | 2.6 | 3.7 |
| Kernel damage% ... | ... | 12.7 | 34.2 | 62.6 |
| Viability% % | 94.0 | 80.5 | 39.4 | 6.8 |

* Thiamin content in insect free kernel was reduced to 9.90 $\mu\text{g/g}$. in 6 months' storage.

TABLE II. Changes effected by insects in groundnut kernels in 6 months

| Insect responsible for damage | Kernel damage % | Viability | Fat acidity as oleic acid% | Yield of Oil % |
|-------------------------------|-----------------|-----------|----------------------------|----------------|
| <i>T. castaneum</i> ... | 53.3 | 27.4 | 3.7 | 46.6 |
| <i>O. surinamensis</i> ... | 69.5 | 16.0 | 4.2 | 46.2 |
| <i>N. Rufipes</i> ... | 71.9 | 25.6 | 3.8 | 46.5 |
| Insect free ... | ... | 88.2 | 1.6 | 49.2 |

The fatty acid content of the oil increased appreciably as a result of insect damage (vide Tables). Also there is little difference between the F.F.A. contents of oil obtained from kernels damaged by different insects. Changes affected in nitrogen and thiamin contents follow somewhat similar pattern as in wheat⁸ and pulses⁶.

Central Food Technological
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S. V. PINGALE
M. SWAMINATHAN

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Technical Seminars

(Convener: A. N. SANKARAN)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during January 1957 are given below:

S (IS) 194 (141)

Studies undertaken in Fish and Meat Technology while on deputation in Australia, by Moorjani, M.N., (January 3, 1957). The fish and meat industries in Australia play an important part in the country's economic structure. The supplies of fish and crustaceae which go to make up the average annual catch of about 40,000 tons have been supplemented in the past six years by increasing quantities of prawns and by small supplies of tuna suitable for canning. Today there are quite a good number of fish canneries in Australia. The speaker gave a general account of some of the aspects of the Australian fish and meat processing industries and then described the following investigations carried out by him.

Effect of freezing on fish muscle proteins: Frozen fish can be kept free from bacterial spoilage for long periods by storage at temperatures below 0°C. However, the texture of fish flesh deteriorates by storage. The changes are affected by various factors such as the species and freshness of fish, seasonal variations and size of fish, rate of freezing, temperature of storage, etc. The main purpose of this investigation was to determine what correlation, if any, existed between the ability of a taste panel to detect this change in texture and the salt extractibility of fish fillets frozen and stored at various temperatures. In addition, an attempt was made to find if the frozen fish muscle under vacuum in hermetically sealed cans could be held for long periods retaining its original fresh qualities.

The fish used in this investigation was Morwong (*Nemadactylus Mactopterus*) a commercial species

in Australia. The fish fillets were packed individually in M.S.A.T. Cellophane bags and stored at -10°C and -18°C after sealing the bags. The fillets packed singly in cans were sealed under 22 inches of vacuum and transferred to frozen storage at -18°C. At monthly intervals, samples were taken from cold storage and fillets examined chemically and organoleptically. The results show that the decrease in protein extractable from frozen fish fillets by a 5 per cent salt solution or the determination of actomyosin was associated with a falling off in quality adjudged organoleptically by texture difference. Frozen fish maintained their quality better at -18°C than at -10°C upto six months. There was no significant difference in the quality of fish fillets stored at -18°C sealed in cans under vacuum and fish stored at this temperature in M.S.A.T. Cellophane bags.

Post mortem changes in sheep muscle: The rate of break down of Adenosine triphosphate is reflected in variations in time of onset of *rigor*, and these in return are possibly controlled by variation of the glycogen content of muscle. Recently it has been reported that the pH at which breakdown of glycogen to lactic acid ceases is characteristic of each muscle. The object of this work was to determine whether the glycogen distribution was uniform in the entire *l-dorsi* muscle of sheep and to correlate these results with the pH and buffering capacity of the muscle. The results indicate that the glycogen of muscle does not differ very much from piece to piece. No appreciable difference exists between initial and ultimate pH values at various points in the

l-dorsi muscle of sheep. The figures obtained for residual glycogen of muscle pieces stored at 0°C for 24-48 hours are noteworthy. In many cases this is 200-300 mg. per cent even though the ultimate pH is never below 5.6. However, the same slices treated with Acronize solution (Aureomycin) and stored at 20°C were found to contain practically no glycogen left. Surprisingly the pH value drops by about 0.1-0.25 unit in case of slices stored at 20°C in comparison with those at 0°C, while one would expect a change of about 0.65 unit. Perhaps glycogen is converted into Glucose-6-phosphate and free sugar instead of lactic acid due to amylase action as shown by the recent work of Dr Sharp on dehydrated meat. Further work is in progress to account for the difference in residual glycogen.

Correlating the significance of the results of these investigations the speaker pointed out that no bacterial activity occurs until the period of *rigor mortis* has well passed its maximum, usually a period of 1 or 2 days in case of fish stowed in ice. Some of the fish pass into *rigor mortis* sooner and remain in that condition for a significantly shorter time than other fish. The possibility of inactivation of the glycolytic enzyme system during frozen storage of fish muscle frozen before the *post mortem* accumulation of lactic acid, with a view to obtaining less drip from the frozen muscle on thawing, requires much further integrated work.

The possibilities of preserving shrimp under frozen conditions were described. In this connection it was pointed out that in Australia, most of the prawn catch is marketed locally as whole cooked and iced.

A beginning has been made of a substantial dollar export trade in frozen prawns to U.S.A.

A process for dehydrating and defatting tissues at low temperature as developed by VioBin Corporation, Monticello, Illinois, was described. It is claimed that the azeotropic process makes not only fish meal for animal feeding but also excellent fish flour for human feeding. Work has already been started to prepare a fairly good quantity of fish flour by this process to evaluate its nutritive value and consumer acceptability trials.

The discussion that followed covered points such as the glazing of fish with ice, the Cryovac vacuum sealing of fishery products, the ideal conditions for freezing of fish and its commercial feasibility, the utilization of fish heads and tails for production of amino acids, the transportation of fish as practised in Australia, the residual amounts of ethylene dichloride in fish flour and its harmful effect on human beings, the freezer burn, the use of antibiotics and refrigerated brine water for prolonging the storage life of fish, partial dehydration before freezing etc.

S(IS) 195 (142)

Effective preservation of pickles, by Anand, J.C., (*January 5, 1957*). Mango pickle is a very popular pickle in Indian houses and large quantities of it are prepared every year. The recipes and methods of preparation of different types of mango pickle differ widely from one part of the country to another and they are perhaps based on the empirical knowledge gathered over a long time with regard to the role of spices and condiments as flavouring substances and natural preservatives. These recipes based on empirical knowledge, however, do not always lead to successful preservation of the pickles and the pickles often are liable to spoilage due to the activity of certain moulds and yeasts which get established in the pickles.

Giving the essential features of Indian pickles, Mr Anand remarked

that they are primarily fruit pickles, as they are prepared mainly from fruits like mangoes, limes, lemons, *amla*, and karonda. Preservation of these fruits in the form of pickles do not involve elaborate curing practices comprising of certain complex bacteriological change as in the case of certain vegetable pickles like cucumber pickles. Mr Anand said that the studies reported were undertaken with mango pickle to collect data on the regional practices in the manufacture of pickles and also to verify the role of spices and condiments, invariably used in these recipes, as fungicidal agents against some of the potential spoilage organisms in these pickles.

Using *Aspergillus niger* and *Saccharomyces cerevisiae* species as test organisms and green mango pulp containing 15 per cent salt as the substrate these studies showed that spices and condiments like aniseed, black pepper, chillies, fenugreek, onionseed, mustard, turmeric, asafoetida, etc., when added in conventional doses did not inhibit the growth of these organisms. Cinnamon and cloves were effective at 1-2 per cent level, but they were not commonly used in mango pickle. Salted pulp fully covered with mustard oil did not stop the growth of *Aspergillus niger*. Garlic and green ginger at 1 per cent and 10 per cent level respectively were also found ineffective. Acetic acid was found to be quite effective at 0.3 per cent level unlike citric acid in which the growth was found to be unrestricted at 0.6-0.7 per cent level.

The conventional chemical preservatives and fungicides, *viz.*, Sodium benzoate, sulphur dioxide, sodium propionate and sorbic acid were also tested for their efficacy in controlling spoilage in mango pickle. These preservatives were found to check the growth of these organisms well within the permissible limits. Sodium benzoate, sulphur dioxide and sorbic acid were able to effectively preserve these pickles at 200 parts per million level and sodium propionate was effective at 500 parts per million level.

Concluding, Mr Anand emphasised the need for evolving suitable methods for making pickles which could not only cater to different tastes but also remain free from spoilage.

The interesting discussion which followed covered points like the effect of roasting spices before adding to pickles, need for proper precautions at the initial stage, need for proper containers, role of stalk in whole mango pickle, need for ensuring uniform salt concentration, preservative properties of chillies in (*Avakoi*) pickle, stability of oils used in the pickles over long storage, selection of varieties of mangoes most suited for pickling, and so on.

The President in his concluding remarks stressed the need for classifying the mango pickles into broad groups. He suggested that organoleptic studies on different types of pickles should be made and that tasting panels should be constituted to develop the regional recipes on sound lines. He further suggested that studies should be undertaken on the role of enzyme systems in mangoes, on darkening and softening of fruits and for developing methods which would prevent shrinkage in whole mango pickles. He also remarked that reduction of moisture in mango slices at the early stage may contribute to longer storage life of the pickle.

S (IS) 196 (143)

Studies on rat control, by Padma, M.C. and Sharangapani, M.V., (*January 19, 1957*). Miss Padma who spoke first pointed out the losses caused by rats to human food and stressed the need for their control. The methods of rat control practised were then briefly reviewed and it was stated that in the food grain stores poison baiting was probably the most suitable method. In this technique, however, it was necessary to ensure attraction to the food offered and maximum intake of the food offered. Trials were therefore carried out in the laboratory to ascertain the foods that were consumed in larger

quantities and were attractive to the rats.

She then described the experiment carried out at the Institute on standardized rats and pointed out that amongst the cereals, pulses and oil seeds, cereals were consumed in relatively large quantities and were preferred to other grains. Further, addition of sugar reduced the intake but salt at the level of 1.5 to 2.0 per cent increased the intake. Spices and other flavouring materials appeared not to be quite effective in increasing the intake when a salted wheat-rice mixture was offered to the rats in commercial stores. A satisfactory intake of the offered food was observed in spite of other food materials being available.

Experiments were then started in the commercial stores to estimate the rat populations by using intake of the food as the index, and to find out the time necessary to effect maximum intake and the effect of poisoning in the general rat population. Results obtained were presented and it was pointed out that in spite of other foods available the intake of the food offered served as a satisfactory index of the rat population. Further, a peak in intake was recorded on the 4th day. Fourth day was therefore considered satisfactory for introducing a poison in the food.

Explaining the behaviour of rat populations in commercial stores, Miss Padma said that usually 2 poisonings at an interval of a fortnight brought down the population to such a low level that the damage from rats to grains was not felt. Further increase of this population depended upon a number of factors. But in the stores under study, the rise was observed to occur mostly through reproduction in the residual number and therefore 3-4 months elapsed before the population reached pre-treatment level. Concluding the speaker referred to the possibility of controlling rat-infestations in commercial stores by offering this simple but quite attractive food to the rats. She also pointed out that large scale

experiments in progress have borne out the assumption.

Shri Sharangapani who spoke next stated that rat-infestation was a major problem in the rural areas too and at the same time their control was rendered difficult due to various factors such as ignorance of the people, possibility of accidents through misplacing of poisoned foods, etc. A rural unit however, could offer an advantage that once the population of rodents was exterminated, a build up would be a lengthy process. The experiment in progress for the last 6 months was then described and it was shown that by 3 poisonings at an interval of 2 months each, the rat population was reduced to one-sixth of the original level, while in a neighbouring village, where no treatments were carried out, the level of population was maintained. He felt that the nature of infestations in the village depended upon the type of construction employed in building residential homes and on the mode of storage of food grains. He also described the difficulties experienced in the handling of the poison and concluded with a warning that though this method of rat extermination was simple, cheap and effective, it had to be carried out under technical guidance of some trained personnel.

Supplementing the talk, Dr Pingale, referred to the difficulties encountered in the extermination of rats from food grain stores and pointed out that the industry wanted the rats not to die in piles of bags and also far away. He stated that a suitable poison would satisfy this requirement and work on these lines is in progress. The discussion that followed covered points relating to free movement of individuals from a group, infiltration into localities under treatment, nature of poisons used, the need for improving the flavour of the baits and the reliability of food intake as an index of rat population.

S (IS) 197 (144)

Freezing Preservation of Mangoes, by Srivastava, H.C.

(January 28, 1957). Freezing preservation has been employed in the arctic regions as a natural means of food preservation since ages and H. Benjamin was granted a patent in England as early as 1842 for freezing foods by immersion in ice and salt brine. But the scientific application of this method of preservation is quite recent and the first real test of consumer acceptance was made only as recently as 1930 by Birds Eye Quick Freezing Process. Of late, U.S.A. and U.K. have advanced much in this field but the literature available for preservation of tropical fruits particularly mangoes is very scanty and so far there is no published data on mangoes available showing successful preservation for a period of one year. The speaker described various treatments used in freezing of mangoes under a series of experiments in order to find out the best treatment, which would preserve the delicate mango flavour and taste. The mangoes were preserved as grated raw fruits for sweet and sour chutney; mango slices in sugar syrup and mango pulp. The product was frozen at -20°F and stored at 0°F . The grated raw mango was successfully preserved for a period of twelve months and afterwards raw mango chutney and sweet chutney were prepared. After a series of experiments it was found that, mango slices could be well preserved in 40 per cent sugar syrup with 0.5 per cent citric acid and 0.5 per cent ascorbic acid. Mango pulp was well preserved with the addition of 0.1 per cent ascorbic acid, 5 per cent sugar and 0.5 per cent citric acid. It was found out that addition of 0.1 per cent monosodium glutamate definitely improved the flavour of mango slices in syrup, as well as mango pulp when compared with control. A number of mango varieties were tested in order to find out their suitability for freezing preservation and the following varieties are in order of preference: Padre, Dasahri, Raspuri, Badami and Neelum. A detailed study was made in order to see the effect of enzymes, metallic contamination

and microbial spore load on the quality and consumer acceptance of the mango slices and pulp. It was found that there was no difference in flavour or taste, when mango slices were frozen with or without peel or when they were kept in ordinary glass jars or Pyrex jars. However, the flavour was better preserved, when cube sugar, free from metallic contamination, was used. The presence of air was seen to affect the product adversely. Blanching had affected the flavour of the product. There was 15-20 per cent loss in ascorbic acid content of edible portion during storage.

The speaker stressed that the time between cutting of the slices, treatment and freezing should be as little as possible. The careful selection of the fruit is very essential and the fruits uniformly ripe, firm and having a brix between 15°-17° gave good results. The freezing and thawing time should be as little as possible in order to have a very good product.

It was found that higher initial spore load affected the flavour adversely. The speaker told the house that a detailed study on the '*Role of psychrophiles on freezing preservation of mangoes*' is in progress, the results of which would be presented later. He read out the detailed synopsis of the work on the subject. A study on the post storage life of frozen products showed that after thawing the rate

of increase in the spore load at room temperature was high and the product can be kept only for twelve hours, while at lower temperatures it can safely be kept for 36-48 hours.

The speaker then presented the economics of the process in detail for a small-scale unit, using one deep-freeze cabinet with a capacity of 432 one lb. honey jars and showed that it safely gives a net profit of 22 per cent. He told that each bottle containing 13 to 14 ozs. of mango slices and 6-8 ozs. of sugar syrup will cost Rs 1-12-0. He further stated that by employing the method developed at the Institute, mangoes can be preserved for a period of 30 months, retaining the mango taste and flavour. The slices stored for 30 months were then distributed to the house for their comments on the organoleptic quality. It was noticed that everybody liked the product and informed the speaker that the slices retained almost the original mango flavour and taste. The speaker suggested that there is a tremendous future for export of this product to foreign countries.

Dr Mathur then explaining the *modus operandi* of the practical application of the process said that in the first instance, the process could be taken up by the big hotels in some of our larger cities. Very shortly, there will be facilities for refrigerated transport in India and then there will be no difficulty

in the distribution of frozen products to the different parts of the country. The marketing difficulty will however remain until some of the leading grocers instal frozen foods display-cabinets. There is no doubt that in time to come this difficulty will be overcome as in other countries. Dr Parpia then gave the details relating to the large-scale production of frozen mangoes by a firm in Bombay, and suggested that the cost of packaging would be much cheaper as compared to canned foods. He pointed out that alkathene bag with wax cartons had been successfully used for the purpose in our country. As against glass jars this package would be much cheaper for transportation and would avoid the problem of collecting empty containers. During the discussion, it was suggested that detailed work should be taken up in order to see the effect of enzymes on the quality of the frozen product and that there should be a panel of expert judges for tasting the product, and statistical methods should be applied in the evaluation of the quality of products. The President in his concluding remarks said that although the problem of flavour retention has been solved, more work should be done in the direction of selection of a more suitable variety for freezing and that the problem of distribution of frozen foods is still to be overcome.

INDIAN FOOD LAWS (*published in August 1954*) pp. v. + 220.

This volume summarizes all important details regarding the history, operation and enforcement of the food laws existing in different States in India, definitions, descriptions and chemical standards for articles of food including permissible additives, (colours, flavours and preservatives) and labelling of foodstuffs. The large number of tables on the comparative chemical standards prescribed for different food commodities in various parts of the country make the book useful for reference and guidance for the public analysts and the legal profession.

Price: Indian = Rs. 4-8-0 (*postage extra*); Foreign = 10 shillings.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Fumigation of Pepper

E (IS) 12913 (330)

Is it possible to control microbial spoilage of pepper by using fumigants? Let me know what is the maximum permissible percentage of moisture at which moulds cannot grow and the ideal temperature for drying pepper without losing any of its good qualities? (Cochin).

Recent investigations at the Institute have shown the possibility of controlling microbial spoilage with fumigants. Fumigation need not, therefore, be taken only to mean insect control. It is in this context fumigation was suggested as a means to control the harmful microbes on pepper.

Pepper, like other food materials is susceptible to mould growth when its moisture content is in equilibrium with 70 per cent or higher relative humidities of the atmosphere (This approximates to 11-12 per cent at 80° F for black pepper).

Drying temperature should not exceed 140° F (60° C).

It may be mentioned that in respect of damage due to endemic infections, drying as early as possible after harvest will be helpful and in respect of surface infections drying any time prior to shipping will be useful. Because of the inherent properties of pepper it is expected that the former type of infection may not be responsible for the spoilage.

After drying, if the kernels are stored in humid atmosphere, moisture content will rise and spoilage may occur though relatively late. Prior to shipping, storage in atmosphere of 40 per cent or less relative humidities is, therefore, preferable. Aeration of the stocks in storage may also be desirable.

Varieties of Asafoetida

E (IS) 14872 (331)

Let me know where from pure asafoetida can be obtained? How many varieties of asafoetida are there and what is the difference between them? (Guntur Dist.).

We are not in a position to advise you as to where you can get pure asafoetida. The only fact we are aware of, is that it is imported from Iran and Afghanistan by a number of merchants in Bombay. Perhaps the Indian Merchants Chamber, Bombay can enlighten you on the subject.

The white, milky substance comes out from the trees which turns into gummy material when dried. It is imported into this country in the latter form. Asafoetida is sold on the market under two varieties, viz., the white variety and the black variety. One is soluble in water and the other in the oil. There is not much difference between these varieties. Asafoetida contains gum and resin besides many substances responsible for its characteristic odour. Where the gum portion preponderates, as in *Hings*, it is water-soluble and where the resin portion preponderates as in *Hingura*, it is oil-soluble.

Fungicidal Wax

E (S) (332)

Give the details of the method of prolonging the storage life of fruits and vegetables kept at room temperature using fungicidal waxes. Can you kindly supply us some quantity of the wax? (Delhi).

Fungicidal waxes are used for the treatment of fruits and vegetables to prolong their storage life. Fruits or vegetables are dipped for 2-3

minutes in an aqueous emulsion of the fungicidal wax containing 6 per cent solids. Subsequently, the emulsion is drained off from the commodities and they are dried in a current of hot air. By this treatment the storage life of the fruits or vegetables is increased at least by 50 per cent at room temperature. We are not selling these waxes yet. It is expected that these products would be marketed in about a year's time by some firm under licence from us.

Preservation of Tomato Puree

E (F) 14828 (333)

Please suggest a method to preserve tomato puree in wooden barrels for later use in ketchup making (Calcutta).

Preliminary investigations on tomato juice preservation have shown that with a combination of preservatives at the rate of 80 p.p.m. sodium benzoate and 1-2 per cent of acetic acid, the juice could be preserved for later use in ketchup making.

If the puree is kept at 10 per cent tomato solids, it will require approximately double concentration for ketchup making and as such, concentration of preservative in puree will be less than that of prepared from tomato juice. It is, therefore, desirable to increase the preservative dose in puree for ketchup making. Puree can easily be preserved with 350 p.p.m. benzoate and 1.5 per cent acetic acid so that the benzoate content in the final product will be within the limits laid down by F.P.O. Slight deterioration of colour in tomato juice is bound to occur due to the ageing, but the following precautions during

packing may be able to control colour changes to a certain extent.

1. During the concentration of tomato juice for the preparation of puree, the sticking and charred portion on the walls of steam-jacketed pans should not be scrapped off because this brownish portion will deteriorate further the colour of the product.

2. The wooden barrels should be lined properly with a mixture of paraffin and bees wax in the ratio of 1:2 and a double coat of wax is desirable to ensure complete coating inside the barrels. Such wax-lined barrels will prevent direct contact with wood.

Food values of oils and ghee

E (IS) 14869 (334)

Please let me know the food and calorie values of coconut oil, groundnut oil, gingilly oil and ghee. (Madras).

The calorie values of coconut oil, groundnut oil, gingilly oil and ghee can be obtained by multiplying the weight of these materials in grams by 9 or, in other words, each gram of these substances represents 9 calories. There is no difference in the calorie value of any of these oils or ghee, the only difference being that the ghee contains approximately 3,300 I.U. per 100g. of Vitamin A. Perhaps you are already aware that the hydrogenated vegetable oil is being fortified with Vitamin A as required by Law.

Preservation of Lemon Juice

E (F) 13009 (335)

May I know the method of preserving lime or lemon juice and storing it over long periods? (Adoni).

Lime fruit (lemon) juice cannot be preserved as such when bottled for any length of time. It may remain safe for a few days during the cold weather. The normal way of preserving freshly extracted lime juice is to add to it potassium metabisulphite at the rate of 1 oz. per 100 pounds of the juice and then put the same in bottles which have been previously sterilised in boiling water for about half an hour and

then cooled. The preservative, potassium metabisulphite is a solid and should be dissolved in a small amount of juice before putting into the bulk juice before the juice is bottled. The bottle should be corked air-tight and then waxed. Lime juice preserved in this manner will keep well for at least a couple of years.

Tomato Sauce

E (IS) 14854 (336)

Please suggest some remedies to reduce the high bacterial count found in the tomato ketchup manufactured by us. (Calcutta).

We would suggest the following remedies to eliminate the high bacterial count in your tomato ketchup:

1. The tomatoes should be washed thoroughly in clean water. If necessary some chemical agents such as 'Teepol' or 'Lissapol' should be added to the water. Then the tomatoes should be washed again in clean water.

2. We do not know what techniques you are using for cleaning the barrels which you use for the storage of tomato juice, but we would suggest that they should be cleaned most thoroughly with boiling water containing the above chemicals and rinsed again in clean boiling water. If necessary the boiling water should be left in the barrel for at least half-an-hour.

3. You have not mentioned anything about the chemicals which you add to the tomato juice when you store it in barrels. It will be advisable to use sodium-benzoate as prescribed in the Fruit Products Order.

4. Care should be taken to see that large quantities of the above preservatives are not added, otherwise when the juice is concentrated for making tomato ketchup the concentration of the preservative will also increase.

5. Perhaps one of the contaminants is the spices used by you. Proper care must be taken to see that these are free from micro-organisms or have a minimum possible bacterial load. The best

solution is to purchase good quality whole spices, grind it yourself and tie it in a small cloth bag, which could be dipped in the ketchup during concentration. The bag should be taken out, squeezed and thrown away.

6. The bottles should be most thoroughly cleaned by using proper chemical detergents.

7. The crown cork or any other cork which you use should also be free from bacterial contamination.

8. The ketchup should be filled hot at a temperature not below 180°F and the bottle should be corked immediately.

After following the above points, if you still find that the bacterial count is not within the legal limits it would be advisable for you to pasteurize the filled bottles of tomato ketchup in boiling water for a period of 15-20 minutes.

Cold Storage of Pineapples

E (S) 14770 (337)

What are the optimum conditions for the cold storage of pineapples? Please give the cold-storage life and post-storage life of pineapples? (Trichur).

The optimum conditions for the cold storage of pineapples are a temperature of 47-50°F and a relative humidity of 85-90 per cent. The approximate cold storage life is 6 weeks. After a cold storage of 6 weeks, the post-storage life of the pineapples is about 4 days during which period they can be marketed. After one week's cold storage the post-storage life would be proportionately longer. The problem of marketing can only be solved satisfactorily by the use of refrigerated transport. You will be pleased to know that the Institute intends to conduct shortly experiments on the refrigerated transport of fruits, vegetables and other perishable foods in collaboration with the Railway Board.

Preparation of 'Gulkan'

E (IS) 14997 (338)

Kindly furnish the details of the method of preparation of 'Gulkan.' (Cuddapah).

'Gulkan' is an indigenous preparation on which no scientific institution has carried out any work but the common practical process is described below:

The Rose petals are thoroughly cleaned of the extraneous matter and washed with running water.

Sugar which should be pure, white and free of any undesirable particles is added gradually to the prepared petals and the whole mass crushed with wooden ladles. The quantity of sugar added amount to $2\frac{1}{2}$ times the weight of the petals, the addition being made gradually to achieve

a thorough mixing. After the whole crushed mass is ready, it is tightly packed in glazed vessels. This is allowed to remain in that condition for 2-3 months during which time the product gets suitably seasoned and is ready for use.

Notes and News

STATISTICAL NOTES

Food Production Statistics for October 1956

| Name of Industry | No. of Units | Production during October 1956 |
|-----------------------------------|--------------|--------------------------------|
| Confectionery | 28 | 596 tons |
| Biscuits | 27 | 1,235 " |
| Flour Milling | 27 | 44,037 " |
| Oil Milling | 78 | 11,750 " |
| Butter (tinned) | 6 | 88 " |
| Cashewnuts | 16 | 1,715 " |
| Dal and gram flour | 2 | 440 " |
| Aerated water | 26 | 38,809 gross bottles |
| Beer | 2 | 23,688 bulk gallons |
| Country spirit | 28 | 2,86,209 proof gallons |
| Indian made foreign liquor | 17 | 21,501 bulk gallons |

(Ministry of Heavy Industries, Government of India)

C.F.T.R.I. NEWS

Visitors

The following distinguished persons visited the Institute during the month of January 1957.

Mr Khan, Director of Postal Services, Madras, on 2-1-1957.

Mr M. C. Athipoon P. Ksemmsri, Central Statistical Officer and Director of the Government Statistical Services, Bangkok, Thailand, on 7-1-1957.

Mr U. Belling and Barleben Krs., Wolmirstedt, Germany, on 11-1-57.

Dr K. S. Ambe, Institute of Science, Bombay, on 16-1-1957.

Dr Scott-Sugden of the U.S.I.S., Madras, on 24-1-1957.

Madame Anna Marie Gade, Medical Officer, World Health Organization, on 28-1-1957.

Tours

Dr V. Subrahmanyam left for tour on 5-1-1957 to Ahmedabad in connection with the demonstration of the Fumigation Process before the Indian Central Cotton Committee, to Delhi for the U.P.S.C. selections and to Calcutta to attend the Indian Science Congress.

Dr G. S. Siddappa proceeded on tour to Calcutta on 6-1-1957 to attend the Symposium organised by the Central Glass and Ceramic Research Institute and also to attend the Indian Science Congress.

Mr D. S. Johar proceeded on tour to Calcutta on 10-1-1957 to attend the Indian Science Congress and to advise Messrs Tims Products on the manufacturing technique of vinegar and to instal a Quick Vinegar Generator.

Mr S. K. Majumder and Mr S. Kuppuswamy proceeded on tour to Calcutta on 10-1-1957 to attend the annual session of the Indian Science Congress.

Mr V. Balu proceeded on tour to Madras on 12-1-1957 to participate in the Madras University Centenary Exhibition.

Dr M. N. Moorjani proceeded on tour to Mandapam on 20-1-1957 and then to Bombay on 28-1-1957 in connection with the work on Fish Technology.

Mr N. S. Kapur proceeded on tour to Nagpur on 20-1-1957 to study the colour losses in tomato products under factory conditions.

Dr W. B. Date proceeded on tour to Pollibetta (Coorg) on 29-1-1957 to make observations on 'Effect of spraying oranges with different harmones'.

Dr M. Swaminathan proceeded on tour to Bombay, Delhi, Calcutta and Madras on 30-1-1957 to organize feeding experiments with Baby Food.

Mr Y. K. Raghunatha Rao proceeded on tour to Bhavnagar on 24-1-1957 to advise the industry on the extraction of edible oil from Rice bran by the solvent extraction method.

Appointments and postings

Mr Y. K. Raghunatha Rao has been appointed as officiating Assistant Director in the Food Engineering Division.

Mr B. Y. Rao has been appointed as Technical Assistant in the scheme on 'Literature Survey on Oils and Fats'.

Nominations

Dr Girdhari Lal has been nominated as Chairman of the Sub-Committee set up by the Central Fruit Products Advisory Committee Government of India, to survey the Chutney Industry in the country.

Dr M. Swaminathan has been nominated as a member of (i) The Dairy Products Sub-Committee (A.F.D.C.—12:2) and (ii) Dairy Laboratory Apparatus and Glassware Sub-Committee of the Indian Standards Institution.

Drs D. S. Bhatia and M. Swaminathan have been nominated as Principal and alternate members respectively of the Edible Starches, Confectionery and Cereal Products Sectional Committee of the Indian Standards Institution.

Mr N. S. Kapur has been elected as an Associate Member of the Indian Institute of Chemical Engineers.

Events

Dr Scott-Sugden of the U.S.I.S., Madras, presented a complete set of Year Books of the U.S. Department of Agriculture to the Institute Library.

Participation in Exhibition

The Institute participated in the Madras University Centenary Exhibition held in Madras from the 28th of January 1957 to the 17th of February 1957. A special demonstration of the different preparations of fruit and vegetable products on home and cottage-scales was arranged with the co-operation of the Metal Box Co. Other sections of the Institute stall at the Exhibition were devoted to the demonstration of the utilization of Indian Multi-Purpose Food; the techniques of disinfestation and preservation of grains developed at the Institute; the various protective foods, food substitutes, supplements and various other products standardised during the last 6 years. The exhibition was inaugurated by

Shri C. D. Deshmukh, Chairman, University Grant Commission and was visited by about 10,000 people every day. Prominent among the visitors were: Mr A. J. John, Governor of Madras, Dr Rm. Alagappa Chettiar, Member of the Governing Body of the C.S.I.R., Dr A. L. Mudaliar, Vice-Chancellor, Madras University, Mr P. V. Rajamannar, Chief Justice of Madras, Mr K. N. Srinivasan, the Mayor of Madras and Mr D. Balasundram, Commissioner of the Madras Corporation.

List of Papers Published

571. **Changes leading to improved culinary properties of rice on storage**, by Desikachar, H.S.R., *Cereal Chem.*, 1956, **33** (5), 324.

572. **Mango cereal products**, by Lal, G. and Jain, N.L., *Res. and Ind.*, 1956, **1** (11), 229.

573. **Studies in packaging and cold storage of betel leaves**, by Iyengar, N.V.R., *et al*, *Bull. cent. Food technol. Res. Inst.*, 1956, **5** (13), 307.

574. **Coconut milk concentrate and powder**, by Siddappa, G.S., Bhatia, B.S. and Lal, G., *Bull. cent. Food technol. Res. Inst.*, 1956, **5** (13), 311.

575. **Utilization of spent wash for the production of fungal amylase**, by Lulla, B.S. and Johar, D.S., *Bull. cent. Food technol. Res. Inst.*, 1956, **5** (13), 312.

576. **Alcohol extraction of oilcakes—Niger seed (*Guizota abyssinica compositae*)**, by Krishnamurthy, R.G. and Raghunatha Rao, Y.K., *Bull. cent. Food technol. Res. Inst.*, 1956, **5** (13), 313.

577. **The place of processed food supplements in school feeding programme**, by Subrahmanyam, V., Narayana Rao, M., Kantha Joseph and Swaminathan, M., *Bull. cent. Food technol. Res. Inst.*, 1956, **5** (13), 314.

578. **Estimation of vitamin B_{12b} (Hydroxo cobalamin) in proteolysed liver extracts**, by Sreenivasamurthy, V., Swaminathan, M. and Subrahmanyam, V., *J. sci. industr. Res.*, 1956, **15C** (10), 215.

579. **Production of amylase in a laboratory-scale fermenter**, by Lulla, B.S. and Johar, D.S., *J. sci. industr. Res.*, 1956, **15C** (10), 233.

580. **Nutritive value and keeping quality of husked, under milled and raw rice**, by Subrahmanyam, V., Narayana Rao, M. and Swaminathan, M., *Bull. cent. Food technol. Res. Inst.*, 1956, **5** (14), 329.

Additions to the Library

(Books Received under the Colombo Plan Aid)

1. **Measurements of particle size in very fine powders**, 1954, by Rose, H.E., (Constable), pp. 127, £0-9-0.

2. **Aids to Bacteriology**, 1954, by Scott-Wilson, H.W., (Bailliere), pp. 390, £0-7-6.

3. **Aids to materia medica for nurses**, 1954, by Squibbs, A.E.A., (Bailliere), pp. 247, £0-5-6.

4. **Edible and poisonous fungi**, 1952, (H.M.S.O.), pp. 63, £0-7-6.

5. **Newer knowledge of hygiene in diet**, 1952, by Wallace, J.S., (Kimpton), pp. 264, £1-16-0.

6. **Medical inspection of school children**, 1952, by Wilkins, E.H., (Bailliere), pp. 224, £0-16-0.

7. **Micro and semimicro qualitative inorganic analysis**, 1954, by Vogel, A.I., (Longmans), pp. 663, £1-2-0.

8. **Modern workshop technology, part I**, 1956, by Baker, H.W., (Cleaver-Hume), pp. 511, £1-15-0.

9. **Black's veterinary dictionary** 1955, by Miller, W.C. and West, G.P., (Adams and Black), pp. 1112, £1-15-0.

10. **Milling**, 1937, (Machinery Pub. Co.), pp. 76, £0-4-0.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

Paper chromatographic studies of some natural coumarins, by Chakraborty, D.P. and Bose, P.K., *J. Indian chem. Soc.*, 1956, 33 (12), 905.—The AA have reported their studies on chromatographic separation and identification of 12 natural coumarins. Twenty-one solvent systems have been described and data on R_f value of coumarins tabulated. According to the authors, the most suitable solvent is water; the R_f values were found to be generally less than 0.75.

D.S.B.

BIOCHEMISTRY AND NUTRITION

Availability of iron from palm gur and cane gur, by Joshi, M.R. and Kamala Sohonie, *J. sci. industr. Res.*, 1956, 15C (12), 272.—Studies on the biological availability of iron present in palm and cane gurs have shown that the iron present in them, is in an easily available form. This is confirmed by the regeneration of haemoglobin in young albino rats, rendered anaemic by bleeding, on supplementing their diets with palm or cane gur.

Minerals in Palm gur, by Joshi, M.R. and Kamala Sohonie, *J. sci. industr. Res.*, 1956, 15C (12), 281.—Palm gur is reported to be a good source of vitamins and also contains a high percentage of ash supposed to contain important minerals. The ash from palmyrah and date palm gur has been analysed for the various constituents and the results are reported in this note. The gurs are found to contain almost all the nutritionally important minerals, Ca, P and Fe are present in good amounts. The low sodium content and high potassium content indicate the possible use of palm gur as a therapeutic agent

in various disorders. Cobalt and nickel are also present in gur and the presence of cobalt is correlated with the presence of vitamin B₁₂ or B₁₂-like factors in it. All the iron being present in easily assimilable form, palm gur can possibly be used in the treatment of anaemia. The laxative property of gur is accounted for by the presence of magnesium.

K.L.R.

FISH

Studies on the chemical quality of cured fish products from the West Coast of India, by Krishna Pillai, V., Valsan, A.P. and Rajendranathan Nayar, M., *Indian J. Fish.*, 1956, 3 (1), 43.—The AA have reported the details and also the defects of the various methods of curing fish adopted on the South and West Coasts as a result of a detailed survey of the important fish curing centres of the coastal areas of India. The Chief methods of curing are: (1) Sun drying, (2) Dry salting, (3) Wet salting, (4) Pit curing and (5) Colombo type of curing. Several samples of different species of cured fish, representative of the above methods, have been collected and a detailed analysis for their chemical constituents has been carried out. Results show that there is a wide variation in the chemical quality of the cured products obtained from different places. Analysis of salt samples used for curing purposes shows a wide difference in their quality and do not conform with the tentative standards proposed for salt for fish curing. The AA conclude that the poor quality of the cured fish products may be ascribed to the defects in the methods followed in each place and to the low sodium chloride content of the salt or to the

high percentage of impurities in the salt used in curing. The present study is an essential pre-requisite for developing improved techniques for curing.

K.L.R.

The bacterial flora, trimethylamine and total volatile nitrogen of fish muscle at 3° C., by Velankar, N.K., *Indian J. Fish.*, 1956, 3 (2), 261.—Preliminary observations on the bacteria associated with fish stored at 3°C and the amount of trimethylamine (TMA) and total volatile nitrogen (TVN) produced during such storage have been reported. Muscle samples of fish kept in a refrigerator were removed at intervals and the bacteria associated with it were identified and the TMA and TVN determined. The results are given in a table. Results of studies on the bacterial flora of fresh fish and fish allowed to spoil at room temperature by keeping in a closed jar for 24 hours, are also given for comparison. Fresh fish was associated mainly with Gram-negative asporogenous rods besides *Bacillus* and *Micrococcus* also being present. The bacterial flora of fish at 3°C consisted of *Achromobacter*, *Micrococcus* and *Bacillus*. Several species of the bacteria of the above groups have been isolated and identified. The amounts of TMA and TVN have a direct bearing on the degree of staleness of the stored fish; higher the values for the TMA and TVN, greater the staleness. The presence of *Bacillus* or *Micrococcus* exclusively in the fish muscle, as found in some cases, appeared to be associated with low values of TMA, indicating that no spoilage has set in. The *Achromobacter* which are Gram-negative, achromic, non-sporeforming rods, are found to be responsible for

pronounced spoilage. In the case of fish kept at room temperature, however, the *Bacillus* was found to be predominant.

K.L.R.

The bacterial flora, trimethylamine and total volatile nitrogen of fish muscle at 0°C (In Ice), by Velankar, N.K. and Kamasastri, P.V., *Indian J. Fish.*, 1956, 3 (2), 269.—Studies were carried out on the spoilage, during storage in ice, of pomfrets, mackerel, horse-mackerel, seer-fish and perches. The duration of storage till the TMA, TVN levels and/or the bacterial count became significant, varied considerably even in fish belonging to the same group; the variation was relatively less where fish with the same previous history were used. The bacterial flora varied considerably, depending, to some extent, on the environment from which the fish were caught. The flora of the muscle at 0°C consisted mainly of gram-negative asporogenous rods and Gram-positive spore-formers; the significance of the latter in causing spoilage at this temperature is doubtful. The paucity of flavobacteria and micrococci at 0°C in this study is noteworthy. The different bacterial types isolated from fish muscle at 0°C (in ice) and also at 3°C are described.

FRUIT AND VEGETABLE PRODUCTS

Acids and sugars in *Eugenia jambolana*, by Lewis, Y.S., Dwarkanath, C.T. and Johar, D.S., *J. sci. industr. Res.*, 1956, 15C (12), 280.—In this note, the AA report the nature of acids and sugars present in the juice of Java Plum or *Eugenia jambolana*. By paper chromatographic analysis of the juice, it has been established that it is the malic acid which is present in the fruit and not citric or gallic acid as reported by earlier workers. The amount of malic acid determined by the polarimetric method was 0.59 per cent on the weight of the whole fruit, which compares with the value of 0.6 per cent obtained as titratable acidity calculated as malic

acid. It has also been shown that only fructose and glucose are present in the juice and no trace of sucrose could be detected.

K.L.R.

Further studies in the control of mango malformation disease, by Singh, S.M., *Sci. & Cult.*, 1957, 22 (7), 394.—Malformation of inflorescences in mango trees is a disease caused by mites, viz., *Tyrophagus castellani*, *Typhlodromus* sp. and *Eriophyes* sp. and it can be controlled by using acaricides. The efficacy of using three acaricides, namely, diazenon, chlorobenzilate and Ovotorn has been studied. Mango trees, selected for the experiment were sprayed with the above acaricide solutions five times during the blossoming period at intervals of 15 days. Spraying with 0.032 per cent diazenon or 0.125 per cent ovotorn helps in minimising the malformation disease and producing about 75 per cent of healthy inflorescence per tree. The average yield of fruits per tree is also good. Use of chlorobenzilate has not been found successful. It has further been shown that with only two sprays of diazenon during winter, the disease can very efficiently be controlled at low cost, yielding nearly 85 per cent of healthy inflorescence per tree.

K.L.R.

Control for fruit rot of Pomegranate, by Rajpal Singh Nirvan, *Sci. & Cult.* 1956, 22 (7), 395.—Pomegranate is affected by a number of diseases caused by different micro-organisms as shown by many workers. *Aspergillus castaneus* causes discoloration of fruits and seeds, while *Sphaceloma punicae* is responsible for the disfigurement of fruits in Mysore. A dry rot of pomegranate fruits prevalent in U.P. has been attributed to *Phomopsis* species and preliminary work had shown that the disease could be controlled by using Perenox, a copper fungicide. The experimental trees were treated with different number of sprays of $\frac{1}{2}$ per cent Perenox (copper oxychloride) with the addition of albolium as a sticker. Spraying was done

soon after the first monsoon rains at intervals of ten days. Spraying $\frac{1}{2}$ per cent peronox solution three times at ten day's interval can effectively control the fruit rot of pomegranate.

K.L.R.

INSECTICIDES

Relative toxicity of some important insecticides to certain species of storage pests, by Pradhan, S. and Bhatia, S.S., *Indian J. Entomol.*, 1956, 18, 34.—Toxicity of DDT, gamma BHC, aldrin, dieldrin, toxaphene and chlordane to *Tribolium castaneum*, *Bruchus chinensis* and *Calandra oryzae* are reported. Against *Tribolium*, dieldrin, aldrin, BHC and chlordane were found to be 11.9, 9, 3.3, and 1.4 times as toxic as DDT. Against *Bruchus* the toxicity ranged as dieldrin > BHC > aldrin > chlordane > DDT and toxaphane. In respect of *Calandra*, BHC was the most toxic and toxaphane the least. In a subsequent test when insecticides were mixed with the grain, *Trogoderma* infestations were observed to be controlled. This was despite high resistance shown by the grubs in the usual bioassay studies.

S.V.P.

Effect of reduced pressure on *Tribolium castaneum* Herbst. and *Trogoderma granaria* Everts, by Narayanan, E.S. and Bhamhani, H.J., *Indian J. Entomol.*, 1956, 18, 196.—Insects that were conditioned, are exposed to a pressure of 4.5–5.0 cm. mercury for different periods and later mortality and loss of water from the insect body are recorded. It is shown that *T. castaneum* is relatively more susceptible to reduced pressures and in both the insects mortality could have occurred through desiccation. The relative difference in mortality is attributed to possible differences in the morphology of the spiracles of the two insects.

S.V.P.

MICROBIOLOGY

Production of amylase on a laboratory-scale fermenter, by Lulla, B.S. and Johar, D.S., *J. sci.*

industr. Res., 1956, **15C** (10), 233.—The AA have tried various mould cultures for the maximum amylase production in wheat bran extract medium and found that *Aspergillus oryzae*, CFTRI 1021, was the best amylase producer producing 295 mg. of maltose per 2 ml. of medium. The effect of formalin and penicillin in the culture medium on the growth and amylase production has been investigated with a view to develop an open fermentation process. Higher concentrations of formalin diminished the mould growth and amylase production. Formalin in a dilution of 1:3000 did not have any such adverse effect. Presence of 16 units of penicillin G had no toxic effect. Different batches of fermentation on large-scale were carried out in open glass fermenter containing 6 litres of sterilized wheat bran extract medium, 2 ml. of formalin and 40 mg. of penicillin G. The contents were inoculated with the mould grown in shake flasks and incubated at room temperature. The amylase produced after different periods of incubation of the various batches was determined. The results indicate that amylase can be produced in high concentration by growing the mould under submerged condition on a bran medium. Addition of formalin and penicillin prevents contamination in the fermenter. The open fermentation process is economical as the mould growth obtained in one batch can be used as the inoculum for the subsequent batch. This also helps early development of amylase in the medium.

K.L.R.

Studies on a Riboflavin Excreting Yeast: Part III—Suitable sources of carbon and nitrogen, by Mitra, K.K., *J. sci. industr. Res.*, 1956, **15C** (12), 257.—Twenty sources of carbon and four sources of nitrogen have been individually tested for their suitability in supporting growth of yeast and riboflavin production. Maximum yields of riboflavin were obtained when glucose, fructose or sucrose was used as the sole source of car-

bon. The yeast is totally incapable of utilizing lactose. Intermediate yields of riboflavin were obtained with other sources of carbon. Asparagine was found to be the most suitable source of nitrogen for the synthesis of riboflavin by the strain. Urea, though less effective than asparagine, could replace ammonium sulphate without significant change in the yield of riboflavin. Potassium nitrate is not utilized. The influence of sterilization of the media on the yield of riboflavin has been indicated.

OILS AND FATS

Chromatographic separation of Glycerides, by Gupta, D.K., Iyengar, B.T.R. and Chakrabarty, M.M., *Sci. & Cult.*, 1956, **22** (7), 400.—The characterisation of the glycerides in fats is still a difficult problem in spite of modern methods developed. All the factors concerning glyceride structure have not been fully explained by any of the four theories existing. The AA have repeated the column chromatographic technique using Indian poppy seed oil with a view to resolve the glycerides into different fractions. The iodine value, saponification equivalent and other characteristics of the poppy seed oil have been reported in a table. The oil has been resolved into 24 fractions on a silica gel chromatographic column using different proportions of petroleum ether and diethyl ether as eluants. The weight of each fraction and its iodine value have been determined. It is found that nearly 93 per cent of the oil has been recovered in the form of fractions, some of them having an iodine value ranging between 160-169 as compared to the original iodine value of 136.2. Pure trilinolein has an iodine value of 173.5. Since the Iodine value of some of the fractions go up to 169, the possibility of separating pure trilinolein through the chromatographic method is clearly seen. The complete characterisation of the fractions is in progress.

K.L.R.

GENERAL

Iodination of proteins in phosphate buffer medium, by Moudgal, N.R., *et al.*, *J. sci. industr. Res.*, 1956, **15C** (12), 269.—Iodination of casein, cattle fibrin, groundnut protein, egg albumin shark-ray collagen and haemoglobin has been carried out in M/5 phosphate buffer, pH 8.0. Phosphate increases the tyrosine availability for iodination in all the proteins tried. Phosphate was found to catalyse the formation of thyroxine from diiodotyrosine. This effect could be demonstrated only in two proteins—cattle fibrin and groundnut protein. The probable reasons for not getting an increase in the other proteins have been discussed.

Studies on the sweet exudate from Indian neem, by Iyengar, N.G.C. and Nagarajan, S., *J. sci. industr. Res.*, 1956, **15C** (12), 279.—The AA have carried out a detailed analysis of the exudate from the upper parts of the stem of the neem tree. The exudate (neem toddy) is supposed to be a nutritive and alterative tonic besides possessing cooling, anti-spirochetal and emmenagogue properties. The composition of the exudate in detail is given in a table. The nature of the various constituents has also been examined. The free sugar fraction consisted of glucose, invert sugar and sucrose. A small amount of sugar was in α -glucosidic combination. β -glucoside was found to be absent. Free amino acids in the filtrate obtained after precipitating out all the protein using trichloroacetic acid have been estimated by Sorensen formaldehyde titration procedure. The free amino acid mixture has been analysed by unidimensional, ascending paper chromatographic procedure and 9 amino acids have been identified. The amounts of these expressed in mg./100 ml. of exudate are: arginine 15.2, tyrosine, 65.0, tryptophane, 333.3, proline, 58.5, glutamic acid 38.8, serine 17.0, phenylalanine 154.5, valine, and one unidentified. The presence of free amino acids, particularly tryptophane, in high concentration, is of interest in

relation to the therapeutic property of the exudate.

K.L.R.

Nature of carbohydrates in palm gur, by Joshi, M.R. and Kamala Sohoni, *J. sci. industr. Res.*, 1956, **15C** (12), 281.—The nature and the amounts of sugars present in different varieties of palm gur are reported in this paper. The values for total reducing and non-reducing sugars have been determined and compared with the values for cane gur. The results show that all varieties of gur contain a major portion of non-reducing sugars. The main difference between palm and cane gurs is in the content of total reducing sugars, cane gur having a very much higher percentage. It is found that 75-85 per cent of the total reducing sugars is accounted for by reducing aldoses. Circular paper chromatographic analysis of the clarified aqueous solutions of gur has revealed the presence of sucrose, glucose and fructose in all varieties of gur.

K.L.R.

Ascorbic acid and Helminthosporiose of *oryza sativa* L.

by Padmabai Pushpananden, *Curr. Sci.*, 1957, **26** (1), 26.—Ascorbic acid has a role in plant metabolism and its presence is responsible for the resistance of the plants to leaf-spot disease. The ascorbic acid contents of rice seeds soaked in water for 48 hours prior to sowing, and 6- and 15-day old rice plants two of them resistant and two, susceptible to leaf-spot disease, caused by *Helminthosporium oryzae* have been reported. The results show that although the ascorbic acid content of the four varieties increases with age, the values for the disease-susceptible varieties are considerably lower than the resistant varieties. The resistance of two varieties to the leaf-spot fungus is due to the higher content of ascorbic acid in them, as has been observed by many workers in mosaic resistance in cabbage and wilt resistance in cotton and red gram.

K.L.R.

Studies in carbohydrates, Part V. Investigations of the gum from *Acacia catechu*, by Hulyalkar, R.K., *et al.*, *J. Indian chem. Soc.*, 1956, **33** (12), 861.—The AA report that gum from *acacia*

catechu is composed of D-galactose (9 mol.), L-arabinose (4 mol.), D-rhamnose and L-glucuronic acid (3 mol.). The ash content of the gum was 3.1 per cent which gave positive tests for Fe^{3+} , Ca^{2+} , Mg^{2+} and SO_4^{2-} . The sample of gum under investigation did not contain nitrogen, methoxyl or acetyl group. The aqueous solution of the gum is neutral and non-reducing.

D.S.B.

Studies in carbohydrates. Part VI. Composition of the mucilage from seeds of *Mimosa pudica*, by Hulyalkar, R.K., *et al.*, *J. Indian chem. Soc.*, 1956, **33** (12), 864.—It is reported that the mucilage from the seeds of *Mimosa pudica* is composed of D-xylose and D-glucuronic acid in the proportion of 5:1 molecules. The gum is non-reducing, neutral and does not contain sulphur, nitrogen methoxyl or acetyl group. It has a high ash content (18.6 per cent) composed of Fe^{3+} , Mg^{2+} , Ca^{2+} and SiO_2 . Experimental proof has been given to show that the mucilage possesses a branched structure.

D.S.B.

PART II (Foreign)

ANALYTICAL

Rapid procedure for estimation of Amino Acids by Direct Photometry of Filter Paper Chromatograms, Estimation of Seven Free Amino Acids in Orange Juice, by Rockland, L.B. and Underwood, J.C., *Anal. Chem.*, 1956, **28** (11), 1679.—An improved procedure is presented for the direct photometric estimation of free amino acids on small-scale filter paper chromatograms. The estimation of total spot density is facilitated by a device for mounting the paper chromatograms in the sample chamber and in front of the photocell of the photometer. Complete amino acid assays are obtained within a 24-hour period. The assay range is 0.1 to 1.0 μ for solutions containing as little as 150 μ per ml. Values are presented for alanine, α -aminobutyric acid,

arginine, aspartic acid, glutamic acid, and proline in the filtered juices of California Valencia and Washington Navel oranges.

Colorimetric Method for Determination of Glucosamine and Galactosamine, by Roseman, S. and Daffner, I., *Anal. Chem.*, 1956, **28** (11), 1743.—A colorimetric method is presented for the determination of the hexosamines which is based upon their conversion to the N-acetyl derivatives. Because N-acetylglucosamine and N-acetylgalactosamine do not yield the same colour intensities when treated under standard conditions, it is possible to utilize the procedure for the analysis of mixtures of the two sugars.

Determination of Calcium and Magnesium in Foodstuffs. Simultaneous Removal of Iron and Phosphate as interfering

Ions by Ion Exchange, by Schilz, W.E. and Krynauw, G.N., *Anal. Chem.*, 1956, **28** (11), 1759.—A titration method using ethylenediamine tetraacetate is described for the routine determination of calcium and magnesium in foodstuffs such as bread, enriching mixtures, and grains, in which iron and phosphate occur in interfering amounts. Murexide and Eriochrome Black T are used as indicators for calcium and magnesium, respectively. The iron is converted into an oxalate complex and is removed with the phosphate by means of a cation exchange resin in the hydrogen form in a small column. The calcium and magnesium are eluted with hydrochloric acid and determined in the eluate; the end points are completely satisfactory. The method is simple and much less time-consuming than the oxalate

nd oxinate methods, and results compare favourably with those obtained by the classical methods.

A new method for the determination of inulin in plasma and urine, by Heyrovsky, A., *Clin-chem. Acta*, 1956, **1** (5), 470.—A new rapid and convenient method is described for the determination of inulin in plasma and urine. The determination is based on the formation of a purple-violet colour by fructose with β -indolylacetic acid in concentrated HCl. Some advantages of the new method are discussed.

BIOCHEMISTRY AND NUTRITION

The Metabolic Role of Zinc, by Vallee, B.L., *J. Amer. med. Assoc.*, November 10, 1956, p. 1053.—Zinc has been shown to be a part of the molecule of the enzyme carbonic anhydrase which contains about 0.33 per cent zinc. The total amount of zinc in the human body has been estimated to be 2 g. and no organ stores it preferentially.

Zinc has often been ascribed a role in the action of insulin, but there is little convincing evidence at present to show that zinc and insulin must combine *in Vivo* to form an active compound. Amorphous insulin has been shown to be as active as crystalline insulin.

Zinc has been shown to act as an activator for other hormones also, and has been found as a posphyrin in the Zinc-Uroporphysin.

Carbonic anhydrase catalyses the reaction $\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3$. Human leucocytes contain a zinc-containing protein which is clearly differentiated from carbonic anhydrase. The nature of the enzymatic activity of this protein is not known. Some of the other enzymes which contain zinc are the carboxypeptidase present in the bovine pancreatic juice and four dehydrogenases which depend for their action on diphosphopyridine nucleotide. 34 per cent of zinc in blood serum exists as a firmly bound metalloprotein and the rest in a

loosely bound state as a metal-protein complex. 'Neither substance has been shown to exhibit enzymatic properties. The loosely bound complex appears to be primarily concerned with zinc transport. The ubiquitous occurrence of zinc and its participation in cellular and gaseous respiration as well as in proteolysis point to its cardinal role in metabolism'.

In pathological conditions like pneumonia, bronchitis, erysipelas and polynephritis, the serum zinc level is decreased significantly. In pernicious anemia serum zinc levels are decreased, which are regained after treatment.

'Marked increases of leucocyte zinc have been seen in patients with anemias refractory to all therapy and accompanied by leucocyte counts below 2000 per cubic millimeter'.

Concentration of leucocytes in acute and chronic lymphatic and myelogenous leukemia is decreased to 10 per cent of the normal value. With successful therapy, the zinc concentration returns to normal. Administration of zinc salts intravenously fails to raise the leucocyte zinc concentration or to influence the course of the disease. A great deal more experience is necessary before studies of zinc can be assigned a decisive diagnostic role. At present, there is no known therapeutic role for zinc in systemic disease.

M.R.C.

Algae as sources of Lysine and Threonine in supplementing wheat and bread diets, by Bundley, J.M. and Ing. R.B., *Science*, 1956, **124** (3221), 536.—The possibility of using algae as a source of amino acids to supplement the cereal diets has been investigated. Two green algae viz., *Scenedesmus obliquus* and *Chlorella pyrenoidosa* have been used for the study. Weanling rats fed various wheat flour and bread diets supplemented with algae showed good growth-rate comparable to the growth observed in rats fed diets supplemented with soya protein, dry skim milk, amino acids viz.,

lysine and threonine, whole dried egg, etc. The results show that the algae, *Scenedesmus* and *Chlorella* are excellent sources of threonine and to some extent lysine also, and they can serve as good supplements to wheat and bread diets. *Chlorella* has been stated to be a better source of threonine than purified soya protein and is equal to several animal protein foods of high biological value when used to supplement cereal diets.

K.L.R.

Effect of Ascorbic Acid on Polyphenol Oxidase, by Ingraham, L.L., *J. Amer. chem. Soc.*, 1956, **78** (19), 5095.—A study is reported of the effect of ascorbic acid concentration on polyphenol oxidase. This study involves measurement of initial rates of oxidation, amount of ascorbic acid oxidized in 5 minutes, and limiting amount of ascorbic acid oxidized. The conclusion is drawn that ascorbic acid does not activate or inhibit either the rate of oxidation of catechol or the reaction-inactivation of the enzyme.

CEREALS

Treatment of wheat with ionizing radiation-III. The effect of breadmaking and related properties, by Milner, M. and Yen Yin-Chao, *Food Technol.*, 1956, **10** (11), 528.—The paper describes gamma irradiation of high quality sample of hard red winter wheat (14 per cent Protein). The dosage employed ranged from 125,000 to 1,000,000 rep. This dosage range is lethal to insects and storage fungi. Irradiation resulted in decreases in germination, but no immediate change in fat acidity, protein solubility or fluorescence of acid extracts of the grain. Marked and regular increase in maltose value as a result of irradiation reflects a sharp increase in the susceptibility of the starch fraction to amylase action and indicates that the starch structure is drastically disrupted on irradiation. Data have been presented to suggest that minimum irradiation dosages lethal to storage fungi responsible for biochemical

deterioration of the stored grain (125,000 to 650,000 rep.) do not damage the bread-making quality; the lower level of irradiation (125,000 rep.) may cause an improvement in bread quality comparable to that produced by potassium bromate.

D.S.B.

COFFEE

No ulcers from coffee breaks, by Schweisheimer, W., *Coffee & Tea Industr.*, 1956, **79** (10), 13.—There is a wrong notion that gastric ulcers are produced due to the increase of hydrochloric acid caused by drinking coffee. The author quotes the work of several investigators to disprove this. It has been established by feeding 75 mg. of caffeine per kilo body weight to cats or injecting caffeine into the muscle of experimental animals that no erosions or ulcers are produced. Experiments on rats also, have confirmed these findings. A very large dose of caffeine, however, proves fatal to the animals. It has been stated that there is no valid reason whatsoever to believe that consumption of caffeine-containing beverages, like coffee and tea, is a causative factor in the origin of gastric ulcers in man. Even ulcer patients can stand a cup of coffee. The development of ulcers has been attributed to psychic factors of the people and the hurried rush with which many people eat their food.

K.L.R.

CONFECTIONERY

Preserved ginger. Part I, by Brown, E., *Coffee & Tea Industr.*, 1956, **79** (10), 55.—The history of the spreading and cultivation of ginger, which is one of the earliest known spices, has been described. The ginger used generally for making the preserve is the Chinese or Canton variety of *zingiber officinale* Roscoe. The details of the method of manufacture of ginger preserve adopted in Canton as reported in a U.S. Consular Report, is given. The process adopted at Hong Kong for preserving ginger has also been described. Salted ginger or

ginger preserved in brine is used for this.

K.J.R.

FRUIT AND VEGETABLE PRODUCTS

Novel Freeze-Enzyme technique peels tomatoes at 6 tons per hour, by Diego Straniero, *Food Engng.*, 1956, **28** (10), 58.—A new rapid method of peeling the tomatoes used for canning and patented by Dr Delfino Cagnoni of Italy has been described. The process consists of immersing the tomatoes in chilled salt solution at 5°F., when only the skin and a layer of flesh immediately under it are frozen in about 30-40 sec. This results in the formation of ice crystals which rupture the flesh cells in the area. The product is then submerged in warm water maintained at 86°F, when enzymes are released from the broken cells. These enzymes dissolve out the pectin which normally holds the skin to the tomato in about 8-10 min. and as a result the flesh floats free in the skin. The skin is removed by a special device and tomato flesh is ready for canning. The action of enzymes in dissolving out the pectins has been proved. A flow-diagram of the complete process is given and the capacity of the plant for peeling is stated to be 6 tons per hour.

K.L.R.

Sweet potato processing: Pilot Scale Rotary Lye Peeler, by Arthur, J.C. and McLemore, T.A., *Food Technol.*, 1956, **10** (11), 541.—The construction of a pilot scale rotary lye peeler for peeling of raw sweet potatoes has been described. Details regarding the operation of the peeler and data regarding the effect of raw storage, variety, size of the sweet potatoes, lye concentration, etc., on peeling and trimming losses have been given. Losses increased with time in raw storage, particularly at a temperature of 50°F. Peeling losses vary with the size of potatoes—the larger the potato the less the peeling and trimming losses. Among the three varieties namely, Unit I Porto Rico,

Goldrush and Earlyport, Goldrush had the lowest trimming losses.

D.S.B.

Canners can cut costs, by Blier, *Canad. Food Industr.* 1956, **27** (3), 23.—The use of a new compound called STIL-BRITE to prevent rusting of cans during processing and storage is discussed. The most likely cause of rusting is briefly stated to be due to the presence of chlorides, sulphates and other salts in water used for processing and cooling. The only way of preventing can rusting, hitherto practised, is the installation of costly air conditioning equipment to control humidity and temperature in the ware houses. This heavy expense has now been made unnecessary through the development of this new and also cheap compound. The required quantity of this compound is added to the processing and cooling water, and the cans will take up a protective film which is invisible to the naked eye and is completely harmless to the consumer. The cost of treatment comes approximately only to one quarter of a cent per dozen of processed cans.

G.V.K.

INSECTICIDES

Evaluation of certain acaricides and insecticides for effectiveness, residues and influence on crop flavour, by Linsley, E.G., *Hilgardia*, 1956, **26**, 1-6.—Evaluation of residue and flavour has been carried out in North California by processing pears from plots which were treated with 5 acaricides, tomatoes from plots treated with 5 insecticides and carrots grown in soils treated with 6 insecticides. Acaricides when used in accordance with described procedures have given satisfactory control of mites without giving rise to serious residues or disagreeable alterations of flavour in the canned fruits.

It is stated that though, BHC and lindane are very effective in the control of many species of wireworms, they should not be used in the soil within 2 years of planting root vegetables due to the undesirable effects imparted to the crop. In

ase of lindane it is also shown that deleterious flavour changes may not be related to presence of toxic compounds since the flavour change might have resulted from nontoxic isomers or degradation products.

Dosages necessary for the control of wire worms in the soil are given in respect of aldrin, heptachlor, dieldrin, chlordane, endrin and DDT. A complete correlation between the negative bioassay and lack of flavour alteration for vegetables from above insecticides is indicated.

S.V.P.

Harvest residues of insecticides in vegetable and field crops resulting from foliage and soil application, by Erwin, W.R., Miskus, R.P. and Hoskins W.M., *Hilgardia*, 1956, **26**, 86-105.—19 insecticides were applied to growing crops and soils and the residue data worked out is presented.

Fairly heavy application of lindane have given very low residues after 9 and 17 days. On tomato even persisting insecticides like dieldrin yield low residues because of the poor adherence to ripening tomato. The rapid disappearance of parathion deposits is well illustrated by artichoke foliage upon which an initial deposit of 9.0-17.7 p.p.m. dropped to 0.3 p.p.m. in 9 days. Malathion from 4.0 per cent dust on artichoke was largely detectable after 2 days. The systemic phosphate OMPA dropped to 2.1 p.p.m. in 21 days from 8.3 p.p.m. and was barely detectable after 44 days.

S.V.P.

Effects of acaricides on flavour of almonds and canned fruits, by Hinreiner, E. and Simone, M., *Hilgardia*, 1956, **26**, 35-45.—Results of flavour studies on the effect of Genite-923 and Ovotran sprays on almonds, and of Genite-923, Ovotran, malathion, Aramite, Sulphenone, Chlorobenzilate, Diazinon, Dimite, Genite-876 and systox on canned peaches, pears and apple sauce are presented.

The data indicate that Genite-923 seems most likely to cause flavour difficulties on peaches. Similarly Ovotran appeared to cause more flavour difficulties than most of the other acaricides in canned fruit. No significant difference can be said to have been caused by Aramite and Sulphenone on canned fruit. With Sulphenone the difference was in favour of the acaricide. This is shown to be due to better flavour production in fruit trees where insect infestation is kept under control. Malathion is shown to cause few, if any, flavour difficulties. The other acaricides were tested for one season only and it is considered unwise to come to conclusions with only one season's data.

S.V.P.

Harvest residues of acaricides used on deciduous fruits, by Miskus, R.P., Erwin, W.R. and Hoskins, W.M., *Hilgardia*, 1956, **26**, 46-59.—Results relating to the different acaricides are presented. In respect of the application of Aramite, Genite-923, Ovotran, and malathion to pears 24-27 days before harvest only Ovotran residue exceeded the level of 0.1 p.p.m. in both fresh and canned, without peeling fruit. In peaches Genite-923 and Ovotran left relatively heavy residues probably because the hairy surface of the fruit would tend to hold any material placed on it. Among other chemicals chlorobenzilate gave residue above 0.1 p.p.m. on fresh pears and OMPA gave residues of 0.6 to 1.2 p.p.m. on fresh pears and 0.1 p.p.m. on fresh pears and 0.1 p.p.m. in canned pears.

S.V.P.

MICROBIOLOGY

Evaluation of microbial standards for foods, by Dack, G.M., *Food Technol.*, 1956, **10**, 507.—The AA have evaluated the importance of microbial standards with a view to prevent grief to the processor due to neglect of sanitary aspects. Most of the pathogenic

contamination is traced to soil, as the animal manures are often used. It has been pointed out that voluntary microbial standards have been established by progressive companies and the National Canners' Association as a measurement for the quality of the product. Most of the discussion relates to microbial standards for frozen foods.

H.A.B.P.

Cell-wall Mannan-Protein of Baker's yeast, by Falcone, G. and Nickerson, W.J., *Science*, 1956, **124** (3215), 272.—Earlier workers had reported the presence of two polysaccharides, glucan and mannan in isolated cell-walls of baker's yeast. The mannan was associated with a nitrogenous matter assumed to be a protein. The AA have isolated a mannan-protein complex from the clear cell-wall fragments obtained by mechanical disruption and differential centrifugation of baker's yeast. The isolated cell-wall material has been analysed and its composition is given. It contains mainly 6.7 per cent protein and 84.4 per cent total reducing sugars. The acid hydrolysate of the clean cell-wall fraction has been found to contain 15 amino acids as demonstrated by two dimensional paper chromatography. In the mannan-protein complex the two components are tightly bound because the polysaccharide cannot be precipitated as the copper complex when treated with cold Fehling's solution. The quantitative amino acid composition, biochemical, immunochemical and physical characteristics of the mannan-protein are being studied.

K.L.R.

GENERAL

Some α -Amino Acids Containing a Sulfonamide Group, by Reisner, D.B., *J. Amer. chem. Soc.*, 1956, **78** (10), 5102.—Structural analogs of glutamic acid containing a sulfonamide radical in place of the γ -carboxyl group have been synthesized and assayed as bacterial and viral growth-inhibitors. K.L.R.



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EFFECT OF DRYING OF RICE BRAN ON OIL EXTRACTION BY ETHYL ALCOHOL

By R. G. KRISHNAMURTHY AND Y. K. RAGHUNATHA RAO

(Central Food Technological Research Institute, Mysore)

In the extraction of oil from rice bran by alcohol¹, a natural dilution of the solvent by the moisture present in bran occurs, necessitating regeneration of the solvent. It is desirable to pre-dry the bran before extraction. The present study was conducted to compare the results of extraction of fresh, moist bran with those of the pre-dried bran.

Experimental

Equipment: For extraction experiments, the equipment used comprised of (1) a 10 gallon, steam jacketed and glass lined Pfaudler pressure kettle provided with a variable speed motor-driven stirrer, the 2" outlet fitted with a 100 mesh wire gauze filter and a water-cooled heat-exchanger to cool the extract, (2) a 50 gallon, steam jacketed, open type stainless steel kettle for drying the bran, (3) a 10 gallon stainless steel still, with accessory condenser and receiver for the distillation of extracts under vacuum and (4) a Westfalia Separator Centrifuge, to recover rice wax from the oil.

Materials: Fresh bran was obtained from a local rice mill, which was milling the early (January) harvest rice. Moisture and oil in the bran

during the first run were nearly equal, each being about 17 per cent. In the second run, bran was dried for 2 hours in the open steam heated kettle stirring the bran manually. Then it was analysed and it contained 3.3 per cent moisture. The solvent employed was commercial absolute alcohol, 99.1 per cent by weight.

Experiment: 40 lb. of bran, moist or pre-dried in two successive experiments, were put into the extractor. Solvent was added, 8 gallons in the first and about 4 gallons in each successive extraction. The inlet hand-hole was closed and low pressure steam admitted into the jacket, 5 p.s.i.g. being maintained throughout the 45 minutes period which was the total period of each extraction. This steam pressure corresponds to a temperature of 102°C of the materials. The internal combined pressure of vapour and air in the kettle recorded 15 p.s.i.g. Each extract was allowed to flow out, under this pressure, after 30 minutes of heating and mixing. The extract flowed out in about 15 minutes. In all experiments, 'fines' were altogether absent in the extract². The extract was cooled to 25°C. The oil phase which separated on cooling was withdrawn. The solvent phase was distilled under vacuum to recover oil, solvent and dissolved sugar. The oil phase was similarly distilled to recover oil and solvent. The extracted bran was finally desolventised by heating in the kettle itself to recover the solvent and meal. Settled wax in the cooled oil was collected by centrifuging. The oil was refined, as usual, by alkali and the refining loss noted.

Results

The experimental conditions and data are shown in Table I and data on oil extraction, distribution and refining loss are given in Table II.

Oil extraction efficiency: Moist and dried bran were extracted using solvent ratios of 5.66 and 3.27 respectively. Corresponding number of extractions were 5 and 3; the total extraction and desolventising periods being 5.75 and 4.25 hours. Yields of the dry extracted bran were

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TABLE I. *Rice Bran Oil*

| <i>Extraction conditions and data of two pilot plant runs</i> | | | | Run No. 1 | Run No. 2 |
|---|-----|-----|--|--------------|--------------|
| <i>Conditions</i> | | | | | |
| Bran processed (lb.) | ... | ... | | 40 | 40 |
| Oil in bran % (Petroleum ether ex- tractives) | ... | ... | | 16.5 | 17.0 |
| Oil in bran (Petroleum ether ex- tractives) (lb.) | ... | ... | | 6.60 | 6.80 |
| Moisture in bran (%) | ... | ... | | 17.6 | 3.3 |
| " (lb.) | ... | ... | | 7.04 | 1.32 |
| Solvent, ethyl alcohol % by weight... | ... | ... | | 99.1 | 99.1 |
| Solvent to bran ratio | ... | ... | | 5.66 | 3.27 |
| Jacket steam pressure (p.s.i.g.) | ... | ... | | 5.0 | 5.0 |
| Extraction temperature (°C) | ... | ... | | 102 | 102 |
| Number of extractions | ... | ... | | 5 | 3 |
| Time of each extraction (minutes) | ... | ... | | 45 | 45 |
| Total time for extraction (hours) | ... | ... | | 3.75 | 2.25 |
| Time for desolventisation (hours) | ... | ... | | 2 | 2 |
| Time for pre-drying (hours) | ... | ... | | ... | 2 |
| Total process time (hours) | ... | ... | | 5.75 | 6.25 |
| <i>Yields</i> | | | | | |
| Bran oil (lb.) | ... | ... | | 6.43 | 6.58 |
| Bran oil % bran | ... | ... | | 16.07 | 16.45 |
| Sugar (lb.) | ... | ... | | 0.96 | 0.45 |
| Sugar % bran | ... | ... | | 2.4 | 1.2 |
| Extracted meal (lb.) | ... | ... | | 23.6 | 30.2 |
| " meal % bran | ... | ... | | 59.0 | 75.5 |
| Oil % in extracted meal | ... | ... | | 0.3 | 0.3 |
| <i>Extraction efficiency</i> | | | | | |
| Oil extracted % oil in bran | ... | ... | | 97.4 | 96.7 |

TABLE II—*Data on oil extraction, distribution and refining loss*

| | | | | Run No. 1 | Run No. 2 |
|---------------------------------------|---------|-----|-----|------------------|-----------|
| | | | | Oil % in extract | |
| I | Extract | ... | ... | 4.1 | 9.7 |
| II | " | ... | ... | 5.4 | 5.3 |
| III | " | ... | ... | 6.4 | 1.7 |
| IV | " | ... | ... | 2.8 | ... |
| V | " | ... | ... | 0.5 | ... |
| Oil in oil phase % extracted oil | | | | 60.2 | 47.3 |
| F.F.A. % oil, from oil phase (a) ave. | | | | 1.1 | 1.2 |
| " from solvent phase (b) | | | | 7.8 | 7.1 |
| Oil Refining loss % in (a) | | | | 7.3 | 9.0 |
| " (b) | | | | 29.4 | 25.0 |
| Overall refining loss % total oil | | | | 16.5 | 17.4 |
| Refined oil % extracted oil | | | | 83.5 | 82.6 |
| " " % oil in bran | | | | 81.3 | 80.0 |
| " " % bran | | | | 13.42 | 13.57 |

59 and 75.5 per cent of the original quantity, the residual oil content being 0.3 per cent of meal in both cases. The yields of oil were 97.4 and 96.7 per cent respectively.

Process dilution of the solvent: From the determination of densities of alcohol recovered from extracts, it was found that in the first case, 91.2, 92.6, 94.8, 95.5 and 95.5 per cent alcohol were

recovered from successive extracts. In the second case, the recovered alcohol from the extracts was of 97.9 per cent strength which represents a solvent dilution of 1.2 per cent.

Oil in extracts: In the extracts from moist bran, oil content increased from 4 to 4.6 per cent, and decreased to 0.5 per cent, whereas, in extracts from pre-dried bran, oil content was 9.7 per cent in the first and decreased to 1.7 per cent in the third extract.

Extracted sugar: Sugar extracted was 2.4 per cent from the fresh bran and 1.2 per cent from the pre-dried bran. The presence of 17.6 per cent of moisture in fresh bran resulted in the greater extraction of sugar.

Rice wax: The settled wax from bran oil was washed with acetone to free it from oil. The purified wax formed 1.33 and 2.0 per cent of the oil, respectively.

Discussions

Pre-drying of bran to 3.3 per cent or less of moisture, introduces process economies. High oil extraction efficiency of 96.7 per cent is achieved with a low solvent ratio of 3.27. A reduction of one third of solvent loss and solvent replacement is also effected, compared with the higher solvent ratio and solvent replacement necessary in extracting moist bran.

By pre-drying the bran, process dilution of solvent would practically be reduced thereby minimising the need of a costly regeneration of the solvent. The continuous high strength of the solvent assures a high oil solubility. As the solvent refining of extracted oil occurs in the process, a recovery of a greater proportion of high grade edible oil is obtained. The high acid oil recovered by evaporation of the solvent phase may be used for industrial purposes.

The total steam requirements, while nearly equal in either method, might be reduced if the bran is pre-dried initially in a separate hot air Louvre drier.

Pre-drying of bran also increases capacity of the extractor by about 30 per cent, on account of the reduction in the number of extractions necessary for desired production efficiency.

Total extraction periods were nearly equal being about 6 hours in both cases. Pre-drying of the bran took about 2 hours, while desolvent-

isation with stirring of extracted bran also required 2 hours. It is estimated that, with a suitable dryer and desolventiser, the required time would be reduced and the total extraction period is expected to be less than 5 hours. Thus a batch extraction of pre-dried bran would be quicker, taking *an hour less* than the extraction of moist bran.

Conclusions

Pre-drying of bran introduces process economies such as a lower solvent ratio, reduction of dilution and regeneration of solvent, increase in plant capacity and reduction of process time.

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2. Graci, A.V. et al., *J. Amer. Oil Chem. Soc.*, 1953, 30, 139.

SCIENCE NOTE

DRYING OF EGGS*

The drying of eggs is an economical method of preserving this product which may be more plentiful in one season of the year than in others. The product resulting from the drying of eggs requires less shipping and storage space. To get the best quality product possible the following egg drying procedures should be carefully followed:

Washing: Eggs are first washed by the hand operation. Broken and cracked eggs should be kept separate from uncracked eggs to prevent spoiling of the sound material.

Candling: Before the eggs are broken, it is necessary to determine their quality. This is accomplished by candling where each egg is examined separately in a darkened room with an 'egg candle'. This is a device that permits rays of light to pass through an egg and thus the appearance of the yolk and white can be ascertained. Candling is not an exact science, but the aim is to separate the eggs into classes which indicate the quality one may expect after they are broken.

The candler takes two eggs in each hand and proceeds, according to the following description: One egg is held with the large end up and in an inclined position before the opening in the candling device. While held in this position, the egg is given a quick twist to turn on its long axis. This sets the yolk in motion and permits the appearance and behaviour of the yolk to be noted. After one of the eggs in the hand is examined an egg in the other hand is placed before the candle, and in the meantime the position of the two eggs

held in the first hand is reversed. In this way, the eggs are alternated before the candle until all have been examined and their quality determined.

As the eggs are candled and graded, they are usually placed in 12 quart galvanized iron pails (keeping cracked eggs separate from sound ones) and carried to the breaking tables. If the whites are to be separated from yolks, the eggs are generally chilled to facilitate better separation.

Unusual appearance of eggs while candling: 'Tremulous' air cell is caused by jars and shocks in handling and shipping. In this condition, the shell membrane becomes separated and permits a tremulous movement of the air cell as the egg is rotated before the candling machine.

The yolk is at the large end of the egg or shell and shell membrane. This may mean a deterioration in the quality of the egg. Normally, the yolk is at the center of the egg, but as it deteriorates the yolk tends to approach the shell.

Dark areas in the yolk may be due to germ development. If large, such eggs are classed as inedible.

Blood rings are caused by death of the developing embryo, resulting in a gathering of rings of blood about the germ spot. Such eggs are inedible.

Dark spots in the white are caused by foreign matter, but their presence does not necessarily render the egg inedible.

Greenish colour of whites or yolks is detected when the eggs are broken. The colour is caused by too much green vegetation in the feed of the

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hens. Such eggs are placed in the lowest class of edible eggs.

Breaking and separation: The eggs are broken against a blunt knife mounted above a small tray which is provided with two to four cups each of which is capable of holding the yolks and whites of about three eggs. The operator breaks three eggs into the cup and then smells the material, and if fresh the contents are poured into a pail beside the operator. If the material is found to be imperfect, the eggs are discarded into large cans or on to a conveyer that removes the material from the plant. Defective eggs, not deemed suitable for human consumption, are used for industrial purposes. One bad egg, if used, can act as a starter for infecting an entire batch of broken-out clean eggs. If by accident, defective material has been mixed with sound stock, the entire batch should be discarded and all equipment thoroughly cleaned and then sterilized with steam.

In cases where yolks and whites are kept separate, a special breaking device is necessary. A sliding hinged separator is attached to the breaking knife. This separator has a receptacle about the size of an egg, and a ring with a sharp edge. The latter is just large enough to fit over the yolk, and serves to cut the yolk from the white as the egg rests in the receptacle. As the whites are cut from the yolk, they fall into a cup and the receptacle is tipped so that the yolk will fall into another cup. The separation of yolk and white is not absolutely clean-cut, and in some instances the white will retain residual yolk. If the vitellin membrane is weakened or ruptured, separation is impossible. As the whites and yolks are separated, they are inspected for odour and appearance.

Churning of eggs: Whole eggs and yolks, after breaking, are lumpy, and it is necessary to crush the yolk skins and to remove particles of shell. This is usually accomplished by churning in a mixing tank and then screening and settling. Egg whites cannot be churned because of excessive foaming, and they are, therefore, forced through fine screens which breakdown the fibrous structure and remove particles of shell.

Treatment of albumen. The albumen of eggs consists of two portions, known as the thick white and the thin white. Only the thin white

possesses proper whipping qualities and it is therefore necessary to reduce the thick white to the consistency of the thin. In commercial practice, this is carried out by fermentation, which should be so controlled as to remove the carbohydrates in the white without digesting the protein.

The whites, prepared as described above, are placed in tanks where the fermentation process takes place. Temperature of fermentation should preferably be 86 degrees F. and should be completed in 72 hours. If fermentation is prolonged, there is a loss of acid, and objectionable odours develop.

One study showed that during fermentation there is a rapid increase in pH of the white from 7.45 to 9.10 within the first 12 hours due to the breakdown of the buffer system through loss of carbon dioxide. After 72 hours, according to the report, the pH drops from 9.10 to 6.25. There would seem to be a close relationship between loss of dextrose and acid formation.

During the first 72 hours of fermentation there is no apparent breakdown of egg-white proteins. At 96 hours the same study showed an increase in combined amide and amino nitrogen value.

At the start of the fermentation, the white separates into two phases: thin white and thick white. The thin white accumulates at the bottom of the tank, while the thick white gradually rises as the pH decreases. All of the mucin, along with some mucoids, accumulates on the surface as a scum. This scum is removed before drying. The bacteria present are usually of the general *Aerobacter* and *Escherischia*. The presence of *Proteus*, *Serrata* and *Pseudomonas* will yield a dull, dingy amorphous product upon drying.

At the end of 72 hours, when fermentation should be completed, the foam at the top of the tank is skimmed off and the liquid drawn off to within about 3 inches of the bottom. Material from both separations, which amounts to from 5 to 8 per cent, is not considered suitable for drying and thus constitutes a loss.

In spite of many attempts to find methods other than fermentation to prepare egg albumen for dehydration, the industry still adheres to the fermentation method. It is considered a necessary step in the production of an albumen of

permanent stability in the dry state, because it removes the dextrose from the product.

Drying of egg albumen. This is usually accomplished in steam-heated cabinet or tunnel dryers. The fermented albumen is spread on shallow pans or trays of aluminum or some of its alloys. The pans are given a thin coating of Vaseline or neutral mineral oil to prevent the dried product from sticking. The initial drying temperature is about 120 degrees F. and this is maintained for 18 hours. During the next 40 to 45 hours, the temperature is raised to 140 degrees F. At the end of this time, the material is removed from the dryer and placed on tables or wire meshes to cool for about 24 hours before it is broken into flakes for packing. Or the product may be put into a 'finisher', a cabinet maintained at 100 to 110 degrees F. It requires from 2 to 3 hours to finish the product in these cabinets.

The dried albumen obtained is known as flake or crystalline albumen. It is not truly crystalline, but because of its sheen and sparkle it appears to possess a crystalline structure. Powdered albumen is prepared by grinding and screening the crystalline product.

Egg albumen cannot be readily spray-dried because it is too viscous and because, for reasons not fully understood, spray-drying decreases the solubility of the product. There is also considerable loss because it has not been found possible to recover all the entrained albumen in the exhaust air from the dryers.

Yields. While the proportion of albumen to yolk will vary according to the quality of the egg and the care exercised in separating the yolk from the albumen, 100 pounds of liquid eggs will yield about 13.7 pounds of dried albumen.

Moisture content of the dried product should be from 7 to 12 per cent.

Drying whole eggs. These are generally prepared by spray-drying, although there is a limited production of pan-dried whole egg, which yields flakes instead of a powder.

Two types of spray dryers are used: the tunnel or chamber type, and the cyclone type. In the former, the air passes through a filter to a suitable fan which delivers the filtered air through heating coils to the drying chamber. Some spray dryers

may be heated by direct fire rather than by steam coils. In the drying chamber, the hot air comes in contact with the atomized eggs pumped into the chamber under pressure of from 1500 to 6000 pounds per square inch. The eggs are immediately dried and dropped to the floor as a powder. In some instances, the powder is allowed to accumulate to a depth of about 4 inches and is then removed by shovels. Other dryers are self-cleaning. As the material comes from the dryers, it is quite hot (the temperature within the chamber varies from about 160 to 220 degrees F.) and may stick together. To prevent this, the dried eggs are conducted to a rotary spiral conveyor to cool and to mix the product, which is finally conducted to a shaking screen from which it falls into barrels.

The chamber dryer must be provided with a dust-collecting system. This is generally another chamber consisting of a series of screens or cloth bags, and connected by a duct with the drying chamber proper. About 1 square foot of screen or bag surface should be provided for every cubic foot of air handled. An exhaust fan in the drying chamber exhausts the air into the dust-collecting system. As the powder builds up on the screens or bags, the static pressure in the drying chamber will increase and it is necessary to remove the dust from the screens. This is usually carried out by an automatic tapping device. In small dryers, the tapping is done by hand. In general, in a chamber type dryer, only about 25 per cent of the egg powder reaches the dust collectors.

In the cyclone type of spray dryer, the air delivery system does not differ to an appreciable extent from that of the chamber type. There is a saving of floor space with the cyclone type, but it usually requires two or more stories to house a cyclone drying plant. When eggs are dried in a cyclone dryer, the dried material is carried by centrifugal force to the sides of the dryer. The drying chamber itself is arranged in the form of a cone and the dried material, following a spiral course, is discharged through an opening in the conical bottom. Many of these dryers have a long blade, or a series of chain links, which revolves in the drying chamber and removes the egg particles from the side walls. If it is not so equipped, it is necessary to stop the dryer at

the end of each day's operation and thoroughly clean the chamber. The cyclone dryer must also be provided with a dust-collecting system.

Spray dryers are provided with varying types of spray nozzles, but each type is so arranged as to distribute the finely divided particles over as large an area as possible. Distribution should, of course, be so controlled that the spray does not strike the walls of the dryer. The nozzle used for eggs may consist of a single hole (about the size of that obtained with a No. 72 drill, 0.0280 inch) or of a hole and a whirling attachment, such as a cup, at the base of which is located the spray nozzle. The nozzle should be so

constructed that the part containing the hole can be easily replaced, because egg products pumped through at high pressures rapidly cut away the hole, thus enlarging it. Because of the tendency of mechanical trouble from high-pressure pumps, spray nozzles may be replaced with a spinning disc. These discs are rotated at very high speeds, and the liquid eggs dropping in a fine stream upon the disc are broken into a fine spray. These discs appear to give less mechanical trouble than high-pressure pumps which are necessary when spray nozzles are used alone.

Drying of yolks: Yolks are dried in the same manner as whole eggs.

REVIEW SECTION

PRODUCTION OF INFANT FOOD AND OTHER PRODUCTS FROM BUFFALO MILK IN INDIA

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The important milk products of commerce are (1) Infant and invalid foods (2) whole and skim milk powder (3) condensed and evaporated milk (4) Butter and ghee (5) Cheese (6) Casein (7) Dried whey and lactose. Methods for the manufacture of the above products from cow's milk have been standardised in several countries. Processing of fluid milk into various products, has considerably helped in the economic utilization of surplus milk and thereby in the rapid development of the dairy industry in U.S.A., Europe, Australia and New Zealand¹. Table I shows the data regarding the production of fluid milk and dairy products in the main milk producing countries of the world as compared with India and Japan². It will be noticed that the U.S.A. is the largest single producer of milk and milk products in the world. It is also of interest to note that Japan with a very low fluid milk production, which is only about one twentieth of that produced in India, is manufacturing many of the milk products on a commercial scale, whereas India is not producing at present appreciable quantities of milk powder and condensed milk. Only recently a beginning has been made in this direction by the establishment of a modern factory

at Anand, which in due course, may meet a substantial portion of the country's requirements³.

India ranks third in the matter of total milk production; the annual production in 1954 amounting to about 19318 thousand tons³, but in view of the large population, the *per capita* daily availability of milk is only about 5 ounces². Added to this, the production of milk varies considerably from province to province from as high an availability figure as 18.8 ounces in Sourashtra to as low a figure as 1.3 ounces in Travancore. During the second five-year plan, steps are being taken by the Food and Agricultural ministries of the Central and state governments to step up the production of milk and also to instal plants for the production of skim milk powder⁴. India is importing at present large quantities of infant and invalid foods, sweetened condensed milk and milk powder. An approximate estimate of the amount and value of the imports during 1954-55 is given in Table I. It will be noticed that the value of the imported dairy products amounts to nearly 68 million rupees⁵. For the purpose of calculating the approximate amount of liquid milk required for

TABLE I. *Annual production of fluid milk and processed milk* products in different countries during 1954 (in 1000 metric tons)*

| Name of country | Fluid Milk | Butter | Cheese | Condensed and Evaporated Milk | | Dried Milk | |
|--------------------|------------|--------|--------|-------------------------------|------|------------|------|
| | | | | Whole | Skim | Whole | Skim |
| Denmark ... | 5,394 | 181 | 81 | 27 | 1 | 8 | 4 |
| United Kingdom ... | 10,974 | 31 | 85 | 115 | 17 | 22 | 28 |
| Canada ... | 7,666 | 152 | 42 | 133 | 7 | 9 | 38 |
| United States ... | 56,110 | 753 | 627 | 1,290 | 343 | 43 | 636 |
| India† ... | 19,318 | 556 | ... | ... | ... | ... | ... |
| Japan ... | 921 | 7 | ... | 49 | 11 | 15 | 4 |
| Australia ... | 5,576 | 162 | 50 | 43 | ... | 19 | 20 |
| New Zealand ... | 4,962 | 188 | 105 | 17 | ... | ... | 40 |

* The amount of milk containing 3.5% fat required for preparing 1 pound of each of the milk products is approximately as follows: butter, 23 lb.; cheese, 10 lb.; evaporated and condensed milk, 2.5 lb.; whole milk powder, 7.8 lb.; skim milk powder, 10 lb. † For the years 1948-52

manufacturing the various products imported at present, the import for the year 1954-55 has been taken as the basis (Table II). In arriving at this figure, approximate fluid milk equivalents of the different categories of products given as footnote under Table I have been used. It will be observed that the total quantity of fluid milk required to manufacture all the imported items, will be approximately 330 thousand metric tons. This will represent only a small fraction (about 1.5 per cent) of the total milk produced in the country. Withdrawal of the above quantity from areas in which milk production is in surplus, is not likely to affect appreciably the fluid milk consumption in those areas. This may, on the other hand, act as an incentive for greater milk production, as has been the experience in countries like U.S.A., Denmark, Australia and New Zealand.

Major milk producing areas in India

The major milk producing areas in India are listed in Table III. When the per capita availability of milk in the areas is also taken into consideration, the important areas having surplus milk production capacity, are Sourashtra, East Punjab, Baroda, and Rajasthan⁶. Other important states producing large quantities of milk are Uttar Pradesh and Bihar. It is also of interest to compare the production of milk from the cow and buffalo in these regions. It will be

TABLE II—*Imports of milk products into India**
(1954-55)

| Item | Quantity (tons) | Value (in million rupees) |
|--|-----------------|---------------------------|
| Butter ... | 613 | 3.80 |
| Cheese ... | 464 | 1.9 |
| <i>Patent Foods:</i> | | |
| Milk food for infants and invalids ... | 2,646 | 12.45 |
| Other sorts ... | 1,625 | 6.73 |
| <i>Evaporated and condensed milk:</i> | | |
| Whole (including cream) | 5,227 | 9.99 |
| Skimmed ... | 587 | 0.71 |
| <i>Dried Milk:</i> | | |
| Whole milk powder ... | 1,200 | 3.92 |
| Skim milk powder ... | 27,206 | 28.49 |
| | | Total value 68.13 |

* Accounts relating to Foreign (Sea, Air, and Land) Trade and Navigation of India, March 1955.

TABLE III—*Production of cow and buffalo milk in major milk producing areas in India (1945)*

| | Cow's milk (in 1,000 metric tons) | Buffalo milk | Per capita daily milk production (ounces) |
|-------------------|-----------------------------------|--------------|---|
| Bihar ... | 799 | 781 | 4.4 |
| East Punjab ... | 676 | 1,400 | 16.9 |
| Uttar Pradesh ... | 1,500 | 2,460 | 7.2 |
| Baroda ... | 36 | 346 | 13.6 |
| Rajasthan ... | 403 | 234 | 15.7 |
| Sourashtra ... | 223 | 410 | 18.8 |

noticed from the data presented in Table III that in Sourashtra, East Punjab, Uttar Pradesh and Baroda, the production of buffalo milk is very much more than cow's milk. The quantity of buffalo milk (330 thousand tons) required for the production of dairy products at present imported, can be easily collected from Sourashtra, East Punjab and Uttar Pradesh without affecting appreciably the fluid milk consumption in these states.

Composition of buffalo milk

The average composition of the milk of Indian cow and buffalo as compared with that of the milk of animals in other countries is given in Table IV.

TABLE IV—Average composition of milk of cow and buffalo*

| Constituents | Indian Cow | Indian Buffalo | European Cow |
|--------------------|------------|----------------|--------------|
| Water ... | 85.28 | 81.74 | 87.40 |
| Total Solids ... | 14.72 | 18.26 | 12.60 |
| Solids-not-fat ... | 9.05 | 10.15 | 8.93 |
| Fat ... | 5.67 | 8.11 | 3.67 |
| Proteins ... | 3.60 | 4.33 | 3.42 |
| Lactose ... | 4.69 | 5.00 | 4.78 |
| Ash ... | 0.76 | 0.82 | 0.73 |

* Rangappa, K. S. and Achaya, K. T., *The Chemistry and Manufacture of Indian Dairy Products*. Published by the Bangalore Printing and Publishing Co., Bangalore, 1948.

It will be seen that the average fat content of the Indian cow's milk is distinctly higher than that of the European cow's.

The average fat content of Indian buffalo milk is about twice that of the European cow's milk.

It is also evident that buffalo milk has a definite advantage economically over cow's milk as a raw material for the manufacture of dairy products in view of its higher fat content.

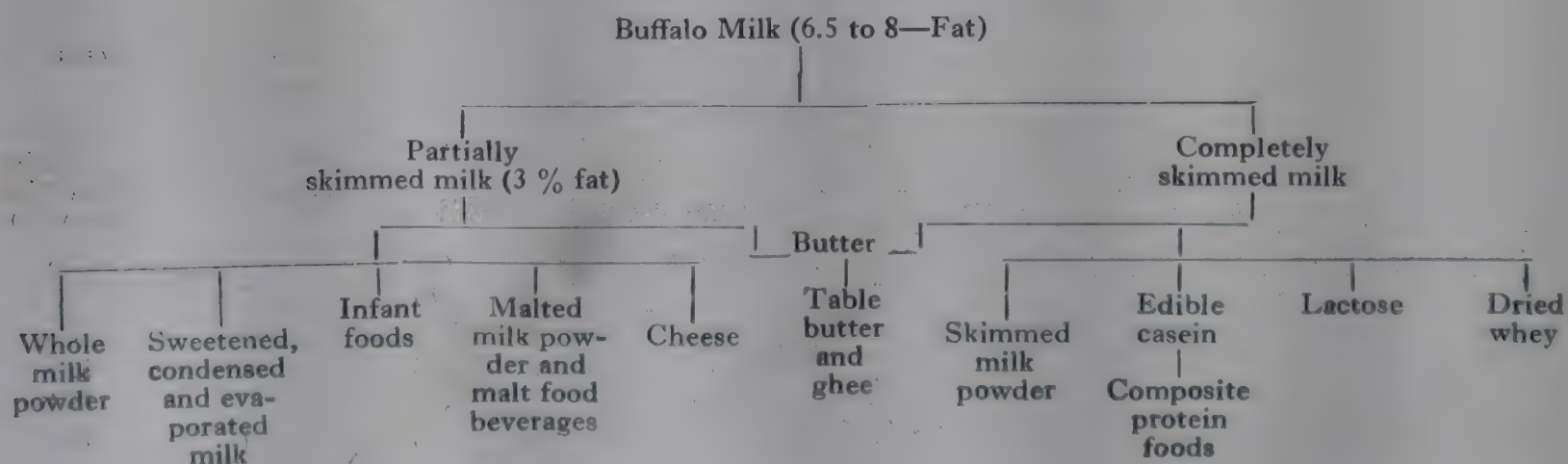
Preparation of various processed food products from buffalo milk

All the categories of milk products which are at present imported, could be prepared from buffalo's milk as shown in Fig. I. Considerable amount of work has been carried out in the Indian Dairy Research Institute on the production of butter, ghee and cheese from buffalo milk⁷. Conditions for the preparation of infant foods, malted milk powder (with and without cocoa flavour) using buffalo milk has been standardised⁸. A method for the preparation of a composite protein food using casein as the base, has also been worked out by Subrahmanyam *et al.*⁹. The steps involved in the manufacture of various products are briefly described below:

Infant and invalid foods: Processed milk foods which are being used as a substitute for mother's milk in feeding infants are of two types: (1) Humanised milk foods and (2) whole milk powder. The conditions for the production of infant food from buffalo milk has been standardised in the Central Food Technological Research Institute, Mysore (Subrahmanyam *et al.*, unpublished). The process consists of the following steps: (1) reduction of the fat content of the buffalo milk to about 3 per cent (2) addition of phosphate buffer to react with the ionised calcium in milk and thereby

FIGURE I

Integrated production of infant foods and food products from buffalo milk



reducing the curd tension (3) addition of cane sugar to bring down the protein content of the powder to about 22 per cent and the fat content to about 14 per cent and fortification with essential vitamins (4) homogenisation (5) pasteurization (6) concentration of the milk in vacuum pans to about 40 per cent solids (7) spray drying and (8) packing in nitrogen gas. The curd tension of the product is low, comparing well with that of imported infant foods. Feeding experiments on infants have shown that they readily digest the food and grow at a normal rate.

Milk foods for invalids that are being imported in large quantities are malted milk powder (e.g. Horlicks, Nestomalt etc.) and malted milk beverages flavoured with cocoa (ovaltine, bournvita and milo). These products are prepared in Western countries using barley malt extract, milk and cocoa. A process for the preparation of the two products using barley or ragi malt extract, milk and cocoa has also been standardised⁸. The products have been found to have a satisfactory shelf life and are similar in taste and nutritive value to those of the imported products. The manufacture of such products could be easily undertaken in the Punjab where both barley and buffalo milk are available.

Whole and skim milk powder: Two different methods i.e. (1) Roller or drum drying and (2) Spray drying, are commonly employed for the preparation of milk powder¹⁰. The advantages of drum drying over spray drying are (1) the relatively low initial cost of the equipment (2) space-saving compactness (3) its suitability to regions of moderate milk production (10 to 20 thousand pounds per day), (4) simplicity and economy of operation and (5) better keeping quality of the powder. Further, roller drying can be profitably conducted both in regions of moderate and abundant milk production. The main disadvantage of roller drying is that the solubility of the milk powder is less than that of spray dried product which is almost completely soluble in water. A commercial type of spray drier can be successfully operated only in areas of abundant milk production (about 90 thousand pounds or more of milk per day). Under Indian conditions it may be advantageous to instal more of roller driers in view of the better keeping

quality of the roller dried milk powder under tropical conditions.

Instant milk powder is a recent innovation and is becoming more and more popular. The process consists in rehydrating, granulating and dehydrating the milk powder under specified conditions¹¹. Standard plant for the process is available¹².

Condensed and evaporated milk: Evaporated milk, sometimes called unsweetened condensed milk, is whole milk (containing 3.5 per cent fat) from which about 60 per cent of the water has been removed by evaporation in vacuum pans. It is about $2\frac{1}{2}$ times as rich as cow's milk in the different nutrients. Sweetened condensed milk is the product resulting from the evaporation of fresh milk to which sucrose has been added. It contains about 28 per cent milk solids and 40 to 45 per cent sugar. Large amounts of sweetened condensed milk are being used in ice cream and confectionery industries. The annual import of these products in India is about 5,000 tons. This quantity can easily be met by internal production. The processes for the manufacture of these products have been described by Harvey and Hill¹⁰ and Hunziker¹³.

Butter and ghee: Butter making is an ancient industry in India, and it is estimated that 556,000 tons of butter are made annually. But the major part of this is made on a home-scale or cottage industry basis. Only one private firm at Anand and one in North India produce butter on a factory basis, apart from Kaira District Co-operative Milk Producers' Union.

Import of butter into the country during 1954 was 613 tons. This quantity can be manufactured from about 8,000 tons of buffalo milk. The skim milk obtained as a by-product can be converted into skim milk powder. Further, there is considerable demand for table butter and ghee throughout India. As such, all the butter and ghee obtained as a by-product in the manufacture of milk powder will find ready market in the country. The Indian Dairy Research Institute, Bangalore, has done valuable work on the preparation and preservation of table butter and ghee and can offer valuable advice and help to the industry in the production of butter and ghee⁷.

Cheese: The present import of cheese is of the order of 400 to 500 tons per annum. Cheese is a product made from the curd obtained from whole, partly skimmed or skimmed milk by coagulating the casein with rennet or lactic acid and with further treatment by means of ripening ferments. Cheese is a concentrated product rich in protein and fat. In the manufacture of cheese, most of the lactose, minerals and water soluble vitamins, are lost in the whey. The manufacture of cheese is a highly skilled process and the success depends to a great degree on the skill and experience of the cheese maker. A possible exception to this statement is the modern method of making Cheddar cheese from pasteurized milk by carefully controlling the conditions¹⁴.

Casein: India is importing considerable amount of casein for use in the preparation of protein hydrolysates and composite protein food and also for use in the preparation of casein glues and adhesives. Casein is obtained from skimmed milk, by the addition of mineral acid, sulphur dioxide or by the action of lactic acid directly developed in the milk by lactic acid bacteria or by rennet¹⁵. After the casein is precipitated, it is separated from the whey by filtration. The separated curd is washed with water in order to remove as much as possible of the acid, lactose and milk salts retained by casein. The casein is then dried and ground to a desired size. It is essential that the skimmed milk used for the preparation of casein should have a very low fat content (below 0.1 per cent), in order to obtain casein with good keeping quality. The use of sulphur dioxide for the precipitation of casein has the added advantage that it helps to preserve the wet casein free from contamination during the whole process.

Dried whey and lactose: Whey is a by-product in the manufacture of cheese and casein¹³. It contains the albumen, lactose, minerals and the water soluble B-vitamins originally present in milk. Large quantities of whey obtained in the manufacture of cheese are dried and used as an ingredient in certain types of cheese spreads and in some canned soups. It can also be blended with milk powder for the production of infant foods. Lactose is generally prepared from the whey obtained as a

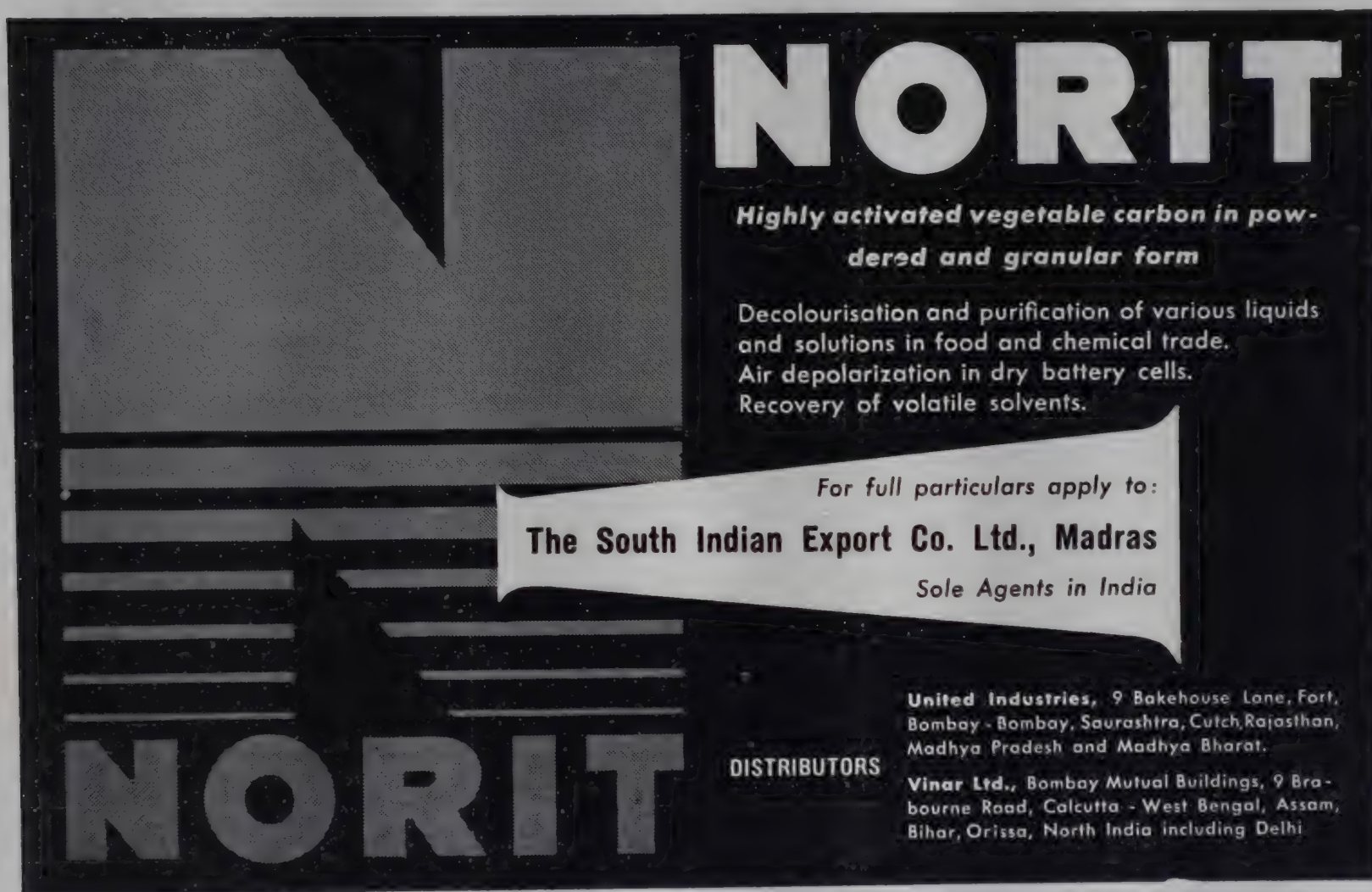
by-product in the manufacture of cheese. It is used mainly as an ingredient in the fermentation medium employed in the manufacture of penicillin. It is also used as a base for making pills and tablets. Lactose is also added to dried milk foods in order to bring the composition of the reconstituted milk closer to that of human milk.

As already mentioned, the country has made a good beginning in setting up a large modern Dairy factory at Anand for the manufacture of milk products. According to available information¹⁶, the Government of India and the United States of America have recently signed an agreement under the technical co-operation programme for the development of the dairy industry. In addition, plans for setting up two factories for the production of skimmed milk powder in Calcutta and Madras under the auspices of F.A.O. have been reported to be ready. It is important to remember that a co-ordinated plan for the production of the various essential milk products to meet the entire needs of the country has to be drawn up. An expert committee on dairy industry representing the various ministries, food and dairy technology institutions and the trade can help considerably in the effort. It is needless to add that the success of the industry will depend to a large extent on the support it gets from the Central and State Governments and the encouragement it gets from the people. Restriction in the import of infant food and other milk products, to the extent of internal production will greatly help in the development of the Indian effort. Granting of subsidy to the national effort may be necessary in the initial stages. With the active support and help from the Government, trade and the people, the country can look forward to the rapid development of this very important and vital food industry.

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TECHNICAL AID TO FOOD INDUSTRIES (published in July 1954), pp. xvi + 270.

This publication contains the views and suggestions of prominent scientists, leading industrialists and food technologists, and Government officials on the nature of technical aid needed by different food industries in the country. Up-to-date technical and statistical data are provided and an appendix embodying the conclusions of the Symposium as well as a comprehensive index are given.

Price: Indian = Rs. 5-0-0 (postage extra); Foreign = 10 shillings.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during February 1957 are given below:

S (IS) 198 (145)

Studies on the micro-organisms responsible for spoilage of preserves, by Mirle S. Subba Rao, (February 11, 1957). Murabba or preserve manufacture is one of the indigenous industries of India which is very popular in northern parts of the country where fruits and vegetables particularly of medical importance are commonly used. While reviewing the present position of the industry, the speaker said that microbial spoilage is one of the limiting factors in successful storage of the product and because of paucity of relevant data available on the systematic study of the problem, the work was undertaken. He isolated 30 yeast cultures from 21 fermented commercial samples of preserves of Apple, Amla, Ginger, Carrot, Bilva and Bihi. He identified them on the basis of their size and shape of vegetative cells; nature of cell division; formation of buds; mycelium or pseudomycelium; mode of ascospore formation, their number, shape and size; growth characteristics on liquid media, agar slants and concentrated sugar solution; fermentation of sugars; and utilization of various organic carbon compounds especially alcohol, as a sole source of carbon and nitrates as a sole source of nitrogen. Out of 30 cultures, 24 were comparable to *Saccharomyces rouxii* and the remaining six with *S. mellis*, according to Lodder and Kreger-van Rij. The speaker then presented the data on the pre-treatment of carrots, which were dipped in various chemicals for half an hour, washed and then made into preserve. HCl, citric acid plus sodium benzoate, Lissopol, and

Teepol were used and washing with ordinary tap water served as control. The samples did not show any sign of fermentation even after three months. Mentioning the future plan, the speaker suggested the use of blend of sugars to enhance the osmotic pressure, and undertaking various processing studies incorporating different yeast cultures.

Initiating the discussion, Dr Lal reviewed the problems of the preserve industry in the light of the 'F.P.O. preserve sub-committee report' and suggested that mostly the spoilage is due to the bad handling and insanitary conditions which can be overcome by advice on proper handling and sanitation to the industry. He further mentioned the use of preservatives, so as to avoid the further processing of the finished product. This was followed by an interesting discussion and the more relevant observations made were about the consideration of economics while packing in smaller cans; preserving the medicinal and nutritional qualities in the finished product and use of such preservatives which are active in the range of the pH of the product. The President in his concluding remarks said that we must try to keep the natural properties, both medicinal and nutritional, of the fruits and vegetables as far as possible, in the finished products. We must produce an ideal product by which the industry may be benefited. He further suggested the preparation of various fruits and vegetables possessing medicinal properties like myrobalans in the form of ideal preserves, under standard conditions, which can easily be taken up by the industry. He also suggested the possibilities of the

use of other sugars e.g. Dextrose or their blends.

S (IS) 199 (146)

Sago, by M. Narayana Rao, (February 16, 1957). Sago was originally being manufactured out of the starch obtained from the pith of the sago palm, but recently root starches, particularly from tapioca is being used extensively. At present sago is being manufactured mainly from tapioca starch in India and other countries.

After giving the definition of sago by the different State Governments and the Central Committee for Food Standards, the speaker dealt with the present status of sago industry in India. There are about 100 factories, both big and small, which are engaged in the manufacture of sago. According to the Tariff Commission Report, Government of India, the annual production of sago in India is about 18,000 tons. The cultivation of a large amount of tapioca and the favourable weather conditions are mainly responsible for the establishment of the sago factories around Salem.

The speaker then dealt briefly with the cultivation of the two important species of sago palm, viz., *Metroxylan sagus* and *M. rumphii* in Malaya. Palm starch sago is not being manufactured at present to any large extent in the world and even those countries where palm sago was manufactured largely have now switched over to tapioca. The steps involved in the manufacture of sago from tapioca roots was then outlined. Tapioca roots are first washed free from dirt, and then both the outer skins are removed. The peeled material is then washed, made into a slurry

by means of a rasper and then passed through a fine mesh sieve which retains the fibre. The suspension of starch is then passed into settling tanks. The starch is partially dried and then granulated by passing through a 10-20 mesh sieve, which is then globulated by means of shakers worked either by hand or by mechanical means. The globules are then graded, roasted, sun-dried and packed in gunny bags.

The speaker informed the house that considerable amount of fibre is obtained as a by-product, and its analysis showed that it contains about 50-60 per cent of starch. A simple method of powdering the fibre and recovering the starch, by tabling was developed in this Institute. This process will help the industry to obtain a greater yield of starch.

The work on the laying down of specifications for Indian sago was undertaken in collaboration with the Indian Standards Institution. More than 50 authentic samples of sago prepared in different factories in Salem were obtained and analysed for the different constituents. A simple and rapid method for the quantitative estimation of fibre in sago was developed. From the analyses, specifications for sago

were laid for moisture, total ash, acid insoluble ash, nitrogen, coloured impurities, pulp and fibrous material, pH of the aqueous extract and loss of starch during cooking.

Since there was a popular belief that palm starch sago was superior to that of tapioca, both in digestibility and nutritive value, studies were undertaken on the *in-vitro* digestibility of samples of sago obtained from different sources, using salivary and pancreatic amylases. No difference was observed in the digestibility of uncooked or cooked sago prepared from different starches. Cooked sago was found to be hydrolysed to larger extent than uncooked sago. Speaking about the nutritive value of sago, the speaker told that irrespective of its source it is a partially cooked starch free from fibre, and did not contain any other nutrient.

The process followed in India for the manufacture of sago has several drawbacks. The speaker outlined the various recommendations made by the Institute for improving the method of manufacture of sago, like (i) prolongation of the storage life of fresh tapioca tubers by fumigation with ethylene dibromide—Methyl bromide mixture (ii) use of dried tapioca chips

for the preparation of good quality starch, (iii) introduction of modern saw tooth-raspers for disintegration of the peeled tubers in order to increase the yield of starch, (iv) arresting the fermentation occurring in settling tanks by the use of suitable preservatives like SO_2 , which can be used either in the form of gas or in the form of metabisulphites, (v) introduction of proper tabling system or centrifugal separators for the separation, (vi) introduction of rotary type of contrivances for roasting sago which will result in a uniformly gelatinised product and (vii) Improvement of the hygienic conditions at present prevailing in the different factories.

The talk was followed by an interesting discussion where points like, cold storage of tapioca tubers, use of dry tapioca chips for good quality starch, temperature of roasting and pilot plant trials on recovery of starch from fibre were raised. The President, in his concluding remarks said that problems like inefficient rasping, mode of granulation, loss of gruel should be taken care of. He hoped that the industry will rally round and make some definite improvements.

BROCHURE ON HOME-SCALE FOOD PREPARATIONS SERIES

This brochure contains 66 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, *viz.*, the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 55 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation; 'Indian Sweet Series' giving methods of preparation and preservation of 3 kinds of typical Indian sweets; and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products.

Price: Re 1-0-0 (*postage extra*)

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Preparation of peanut butter

E (IS) 15351 (339)

What is the method of preparation of peanut butter? Please give its composition also. (Morvi).

Peanut butter is usually made from good quality peanuts (ground-nuts). To stabilise the peanut butter, solid hydrogenated peanut oil (such as Dalda, Pakav, Marvo, etc.) is added to the ground peanuts upto 2 per cent, the amount depending upon the type of nuts, degree of solidity and the temperature. The mixture is then run through a homogeniser. The composition of peanut butter is as follows:

| | |
|--------------|----------------|
| Water | 2 per cent |
| Protein | 28-29 per cent |
| Fat | 46 per cent |
| Starch | 6 per cent |
| Sugars, etc. | 6 per cent |
| Fibre | 2 per cent |
| Salt | 4 per cent |

For preparation of peanut butter, Bauer No. 303 Nut Grinder is used. It is available from the Bauer Bros. Co., 1711, Sheridan Ave., Springfield, OHIO. The capacity of this grinder is 800 pounds per hour using 10 H.P. It gives smooth peanut butter.

Toxic substances in cashew kernels

E (S) 12992 (340)

Are there any toxic substances present in cashew kernels? (Cochin).

The cashew kernels are entirely free from particles of shell which contains anacardic acid and cardol. So far as cashew kernels are concerned, anacardic acid and cardol are not present in sufficient quantities to cause any harm to consumers.

Packing of malted biscuits

E (IS) 16219 (341)

Kindly let me know whether you consider a tin container better than cellophane paper packing for malted biscuits and malted rusks, and whether vacuum sealing is absolutely necessary to improve the keeping quality. (Madras).

Biscuits are hygroscopic by nature and tend to absorb moisture from the atmosphere and thereby lose their crispness and become unacceptable. So the biscuits have to be protected against water vapour. They also develop rancidity when exposed to air, on account of their fat content. Thus the packaging material will have to be impermeable to oxygen.

Flexible packaging materials like waxed paper and moisture proof cellulose film could be used for wrapping biscuits. Sufficient care must be taken to obtain a proper seal otherwise even though a good barrier material is used, water vapour can get in through defective sealing. Creasing or folding increases the water vapour permeability of waxed paper but it has only a slight effect on moisture proof cellulose film.

Polyethylene is unsuitable for biscuits containing a higher fat content since it is permeable to gases, thereby resulting in the rancidity of fats. Moisture proof cellulose film of 'biscuits-grade' appears to be a more suitable material.

The above packaging materials could be used when a short shelf-life is needed. If a longer shelf-life is desired, the biscuits will have to be packed in tins. Vacuum sealing seems to be unnecessary.

The choice of a right type of packaging material depends on (a) the composition of the biscuits and (b) the shelf-life needed. Once the above basic information are available a suitable package could be designed.

In the case of malted rusks, the problem is almost similar to malted biscuits. The product has to be protected against water vapour. In view of its lower bulk density a larger area of wrapping material is necessary for a small quantity. Use of tins will make the product expensive to the domestic buyers. Since it contains very low fat, polyethylene or moisture proof cellulose film appear to be suitable.

The above observations are of a general nature. Laboratory work will have to be undertaken to make specific recommendations once the composition of the product is standardised and the desired shelf-life is made known.

Cold storage of potatoes

E (S) XXXX (342)

Is the Simla variety of potatoes suitable for being stored at low temperatures? What are the conditions required? Let me know the extent of wastage during the cold storage. (Madhya Bharat).

All types of potatoes store well in cold storage. The Simla variety grown by you is certainly suitable for cold storage. The optimum conditions for the cold storage of potatoes are a temperature of 35-38° F and a relative humidity of 85-90 per cent. The approximate storage life is 9 months. Seed potatoes can be cold stored without any detriment to their germination capacity.

The extent of wastage for a such in sheet form or made into period of 8 months during the cold slabs or bars. storage of potatoes at 35-38°F and R.H. 85-90 per cent would be as follows:

| | per cent |
|---|-------------|
| Due to physiological loss in weight, i.e., losses due to loss of moisture and respiration | 3-4 |
| Losses due to various diseases | 2-6 |
| Total | 5-10 |

Preparation of fruit sheets

E (F) 16340 (343)

What is the method of preparing fruit sheets from amla or mango fruit? (Bareilly).

Fruit pulps of thick consistency like those of mango, banana, papaya, etc., have been utilized in this laboratory in the preparation of fruit bars and slabs, as well as fruit toffees. All these products contain most of the nutritive constituents of fruit (s) from which they are prepared. The processes for the manufacture of these are covered by two patents and if you are interested you may please correspond further in this connection, with the Secretary, National Research Development Corporation, Mandi House, Lytton Road, New Delhi.

Another highly nutritive product that we have developed in this laboratory is prepared in the form of sheets, slabs or bars from Amla and mango pulps. The method for the preparation of this is as follows:

| | |
|--------------------------|----------|
| <i>Recipe:</i> Amla pulp | 50 parts |
| Mango pulp | 50 parts |
| Sugar | 30 parts |

The above ingredients are mixed together and dried into sheets as in the case of mango pulp. Drying is done in Aluminium, enamelled or stainless steel trays (flat bottom) at 50°C. Trays are smeared lightly with an edible oil. The dried product is of light yellowish colour and palatable. It may be used as

Pectin from apple

E (F) 16973 (344)

Will you kindly inform me the method of preparing pectin from apple and whether such a pectin is a 'pure' pectin or 'chemical' pectin? (Calcutta).

Apples are washed with dilute hydrochloric acid to remove any spray residue. They are then crushed and the juice extracted with a hydraulic press, which is utilized for the manufacture of cider or sold as unfermented apple juice. The pomace left over after juice extraction is dried for the preparation of pectin in the off season. At the time of extraction of pectin, the dried pomace is leached with water to remove colouring and flavouring materials and any sugar and the washings collected and used for the preparation of vinegar. The leached pomace devoid of any juice is heated with acid under certain conditions to extract pectin. The liquid pectin thus obtained is precipitated with alcohol or by other means, purified, dried and powdered.

From the above, you will find that the pectin made from apples devoid of any juice does not contain any nutritive constituents and as such it is called 'chemical pectin'. For this reason, the jelly made from such a pectin is called 'Synthetic jelly'.

Preparation of synthetic syrups

E (F) 16932 (345)

May I know the method of preparation of synthetic syrups? (Alwar).

Sugar and water are placed in a pan and brought to boil. To remove the impurities of sugar, a small quantity of skimmed milk is added to the boiling syrup followed by a small quantity of citric acid to invert a portion of the sugar (sucrose) to avoid crystallization of sugar when the syrup is cooled. The syrup is further clarified by filtration and appropriate quantity

of flavouring material and colouring matter added to it.

Normally a syrup containing 66-70 per cent sugar does not spoil if made under hygienic conditions and packed in properly sterilized bottles and corks. If desired, a preservative may be added to the syrup. According to the F.P.O., use of 350 p.p.m. sulphur dioxide or 600 p.p.m. of Benzoic acid is permitted in synthetic syrups as a preservative.

Preparation of preserves

E (F) 16932 (346)

Please furnish the details of the process of preparing preserves from fruits (Alwar).

The method of preparing the fruit preserve is given below:

(i) *Washing:* The fruits are washed thoroughly to remove extraneous matter. If the fruit has been sprayed with Bordeaux mixture or arsenate of lead to check blight, it should be washed with dilute hydrochloric acid, especially when peels are to be used for making by-products.

(ii) *Preparation of the fruit:* The preliminary treatment varies with the kind of fruit used. For example, apples and pears are only peeled and punctured, if they are to be kept whole; otherwise they are peeled, halved or quartered, cored and punctured. Mangoes are peeled, sliced and punctured. Petha is sliced, peeled, pricked and placed in dilute lime water for sometime.

(iii) *Cooking of preserve:* The prepared fruit is cooked in water until it becomes tender. Sugar equal to half the weight of the prepared fruit is taken and the boiled fruit and the sugar are placed in alternate layers in a vessel and allowed to stand for 24 hours. During this period, the fruit gives out excess of water and sugar goes into solution. Usually the syrup will be of 37-38° Brix. More sugar is added to raise the strength of the syrup to about 60° Brix and a small amount of citric acid (1-2 ounce per 100 lb. sugar used at the start) is

also added to invert a portion of the cane sugar. The whole mass is then boiled for 4-5 minutes and left for 24 hours. On the third day, the strength of the syrup is raised to about 68° Brix and the mass boiled again. Finally, the strength of the syrup is raised to 70° Brix and the product packed in containers.

(iv) *Packing of preserve*: At the time of packing, the fruit is drained from the syrup and put into dry containers. A freshly prepared boiling hot syrup of 68°-70° Brix is poured into the containers and the containers (A 2½ size cans) exhausted for 8-10 minutes at 212°F and sealed air-tight.

(v) *Sterilization*: If the preserve is packed scalding hot in dry containers, subsequent sterilization may be omitted. It is, however, desirable in large scale production to sterilise the sealed containers to avoid any chance of spoilage. A 2½ size cans may be sterilised for 25 minutes at 212°F and cooled immediately.

Spoilage in preserves

E (F) 17033 (347)

What are the probable causes of spoilage in preserves and how to remedy them? (Hathras).

1. *Causes of spoilage in preserves*: There are several causes of spoilage of preserves. They are:

(a) The soluble solids of the product may be less than 68 per cent which is the minimum specified limit under the F.P.O.

(b) During the slow process of preserve making, there is a likelihood of spoilage of the product due to fermentation in the initial stage when the percentage of the sugar in the syrup is low. It is very difficult to arrest such a fermentation at a later stage. This can, however, be controlled by boiling the product at proper intervals.

(c) Cooking of the fruit with syrup too quickly or in a heavy syrup also causes spoilage. In this case, the syrup does not penetrate uniformly throughout the body of

the fruit although syrup may attain the right degree of Brix. In such cases, the fermentation in the product starts within the fruit and makes the product frothy. The gases produced during fermentation until the concentration of sugar in the fruit is equalised to that of the syrup due to osmosis, cause puffing of the cans.

2. *Method of controlling of spoilage in preserves*:

(a) The preserve should be packed scalding hot into the cans. Alternately, the cans should be exhausted for 8-10 minutes at 212°F (boiling water). The sealed cans should be sterilized in boiling water (212°F) for 25-30 minutes depending on the size of the can.

(b) The F.P.O. permits the use of 200 p.p.m. Benzoic acid to avoid spoilage in the preserves. It should be used in the form of sodium benzoate and must be dissolved in a small quantity of water before use.

(c) The soluble solids of the product must be kept at a minimum level of 68-70 per cent to avoid spoilage.

Crystallisation of sugar in a preserve

E (F) 16974 (348)

Let me know the steps that should be taken to prevent the crystallisation of sugar in a preserve. (Delhi).

To avoid crystallization of sugar in a preserve, the following chemical control in its manufacture should be adopted.

1. Acidity of the product should be kept at a level of 0.1 per cent limit throughout the processing period.

2. 1-2 ounces of citric acid should be added to the product per 100 lb. of sugar, whenever sugar is used to raise the Brix of the syrup.

3. Sugar which has been previously inverted, should be used in conjunction with cane sugar in the ratio of 1:3.

Jujube candy

E (F) 18480 (349)

I would be highly obliged if you can furnish me the details of the method of candying jujubees. (Anantapur Dist).

The details of the method of candying jujubees are as follows:

1. *Selection and pricking of fruit*: Large sized-fruits which just begin to turn yellow are pricked deeply all over the surface with any suitable hand worked device which has a number of thin pin-like prongs sticking out. This process facilitates the absorption of sugar uniformly throughout the fruit in the subsequent candying process.

2. *Salt curing*: Steep the pricked fruit in a 2 per cent common salt solution. Add calculated amounts of the common salt so as to increase the strength of brine by 2 per cent every 24 hours to get a final concentration of 8 per cent common salt in the solution. (This will take four days). Then remove the old brine and put fresh 8 per cent brine containing 0.1 to 0.3 per cent of sodium or potassium metabisulphite. Store well in an ordinary wide mouth screw type glazed vessel of any desired size.

3. *Candying process*: Boil the salt-cured fruits till it becomes soft and most of the salt absorbed by the fruit is removed. Prepare 30 per cent sugar syrup (4½ lb. sugar per gallon), add 0.1 per cent citric acid (about 1½ oz. in 100 lb.) to the syrup and boil for 10 to 15 minutes. Pour the hot syrup over the fruit placed in an aluminium or a stainless steel vessel till the fruit is completely submerged in the syrup (A stainless steel or aluminium plate of convenient size can be put on the top of the mass with some weight on top of the plates so as to keep the fruit completely submerged in the syrup). Next day drain off the syrup, add enough sugar to bring the syrup to 35 per cent strength, boil for 10 minutes and pour back the syrup over the fruit. In this way, increase daily the strength of the syrup by 10 per cent sugar, repeating the process of boiling, etc., till the

syrup reads to 60 per cent concentration of sugar. After this stage, the syrup strength should be raised by 5 per cent on alternate days in a similar way as above till the candying syrup records 75 per cent concentration of sugar. Keep the fruit in this syrup for three days.

4. *Drying and packing:* Drain out syrup and dry the fruit on a wire gauze tray, preferably in shade. Pack the dried jujubees in a desired container and store in cool and dry place.

5. *Utilization of left over syrup:* The syrup left over may be used either for squash making and syrup making or reused for candying

fruit. In the latter case, the syrup is diluted with water to 30 per cent sugar concentration and the candying process is carried out.

Firms supplying food colours E (IS) XXX (350)

Will you kindly give me the names of the firms which can supply synthetic food colours approved under the Food Adulteration Act? (Trichur).

You may kindly contact the following firms for the supply of synthetic Food Colours approved under the Food Adulteration Act:

1. The Amalgamated Chemicals and Dyestuffs Co. (P) Ltd.,

Dadajee Dhackjee Building,
Dr Annie Besant Road,
Worli, Bombay-18.

2. M/s Ciba Dyes (Private) Ltd.,
Royal Insuce. Buildings,
Jamshedji Tata Road,
Fort, Bombay-1.
3. French Dyes and Chemicals
(India) Private Ltd.,
'Adelphi',
3, Queen's Road,
Bombay-1.
4. The Imperial Chemical Industries (India) Private Ltd.,
'Crescent House', Ballard Estate, Bombay-1.

Notes and News

STATISTICAL NOTES

Food Production Statistics for November and December, 1956

| Name of Industry | No. of Units | Production during November 1956 | No. of Units | Production during December 1956 |
|-----------------------------------|--------------|---------------------------------|--------------|---------------------------------|
| Confectionery | 34 | 759 tons | 32 | 916 tons |
| Biscuits | 27 | 1,236 " | 24 | 1,147 " |
| Flour Milling | 32 | 47,316 " | 30 | 49,801 " |
| Butter (Tinned) | 6 | 91 " | 6 | 80 " |
| Cashewnuts | 15 | 1,188 " | 14 | 1,096 " |
| Dal and Gram flour | 2 | 683 " | 2 | 368 " |
| Aerated Water | 31 | 47,325 gross bottles | 29 | 33,304 gross bottles |
| Beer | 2 | 33,735 B. gals. | 2 | 61 121 B. gals. |
| Country Spirit | 28 | 357,946 " | 28 | 384,748 " |
| Indian made Foreign Liquor | 17 | 40,694 " | 17 | 44,405 " |

(Ministry of Commerce and Industries, Government of India.)

Review of the Indian Standards Institution Annual Report

The Report records that the Institution issued 144 Indian Standards (including 2 revisions), during 1955-56 as against 123 in the previous year. This brought the total number of Indian Standards published and in press up to 31st March 1956 to 760.

Out of 734 Indian Standards published, 564 had been adopted by the Central Government till 31st March 1956. Besides, various

State Governments and local bodies had expressed their keen desire to follow Indian Standards Specifications.

During the year, the I.S.I. opened its first Branch Office at Bombay. The Branch Office disseminates information to the industry regarding the work of the Institution, helps and advises those engaged in industry and commerce who wish to implement or adopt standards, conducts technical enquiries and preliminary inspection in con-

nection with the I.S.I. Certification Marks scheme, and holds stock of Indian, British, A.S.T.M. and I.E.C Standards for reference purposes and for sale to the public.

Certification Mark for Wrought Aluminium Utensils

The Indian Standards Institution has granted two licences; one to M/s. Deccan Aluminium Stores, 56, 1st Bhoiwada, Bombay and the other one to M/s. Light Metal Works, New Sun Mill Compound, Delisle Road, Bombay for the use of the Certification Mark of the I.S.I. on Wrought Aluminium utensils, thus bringing the total number of licences granted up till now to the aluminium industry to 13.

The Standard Mark consisting of the monogram of the Indian Standards Institution superscribed by the number designation of the Indian Standard together with the grades of the material, will certify that aluminium utensils manufactured by the firms satisfy all the requirements given in the Indian Standard Specification for Wrought Aluminium for Utensils (IS:21-1953).

C.F.T.R.I. NEWS

Visitors

Dr David E. Green, Director, Enzyme Research Institute, Wisconsin, U.S.A., visited the Institute on 1-2-1957. He also addressed a seminar on 'Fatty acid oxidation and synthesis'.

Animals generate almost all their energy by oxidising sugars and fats. Although a great deal of information is available as regards the utilization of sugars, knowledge about the way fat is oxidised in the body is comparatively of recent origin. Fat, before undergoing oxidation is hydrolysed and it is the fatty acid component that is the main source of energy.

At the beginning of this century, the German biochemist Knoof synthesised two kinds of phenyl fatty acids, one with an even number of carbon atoms and the other with an odd number. He fed these to dogs and analysed the animal's urine for the excretion products. As expected by him, he found that the two types of acids gave different end products, benzoic acid and phenyl acetic acid respectively. From this, he concluded that the fatty acids were degraded two carbon atoms at a time down the chain, each time a carboxyl group being formed at the cleaved end. This is known as 'Knoof's β -oxidation theory'.

About the same time in 1906, a German chemist Embden tried to study the fatty acid metabolism in isolated liver with the circulation intact. Although he was able to show the oxidation of various fatty acids yet he ended with a compound—a diacetic acid—and could not isolate any intermediate product. In 1935 Guastel employed the liver slices. He more or less had the same results as his previous workers and could not suggest anything about the pathway of this oxidation. Thus, one of the major difficulties of the early investigators was their inability to isolate any intermediary products. Although Knoof's β -oxidation theory was receiving support, the progress in

proving the essential correctness of his theory was slowed down because of lack of cell free system which would carry out the above reaction.

These studies got a tremendous impetus when in 1943 Leloir and Munoz of Argentina prepared tiny granules from guinea pig liver cells, later called mitochondria—which could carry out oxidation of fatty acids, as was done by whole liver and tissue slices.

Once a cell free preparation was available, work was really speeded up. Results in Dr Green's laboratory showed that free fatty acids as such were not oxidized but had to be converted first to some other form. It was also noticed that a member of the citric acid cycle was necessary to start the reaction—sort of a sparking phenomenon.

At this stage important pieces of information from independent sources helped the progress of the problem. First it was observed that two compounds, gramicidine and 2:4 dinitrophenol which had no effect on the citric acid cycle eliminated the fatty acid oxidation. One of these compounds 2:4 dinitrophenol is known to inhibit oxidative phosphorylation although it enhances the respiration of rat liver slices. Thus it appeared that somehow a phosphorylating step was involved in the fatty acid oxidation at some stage and that this phosphorylated compound (later shown to be adenosine triphosphate) helped the transformation of the free fatty acid into its active form.

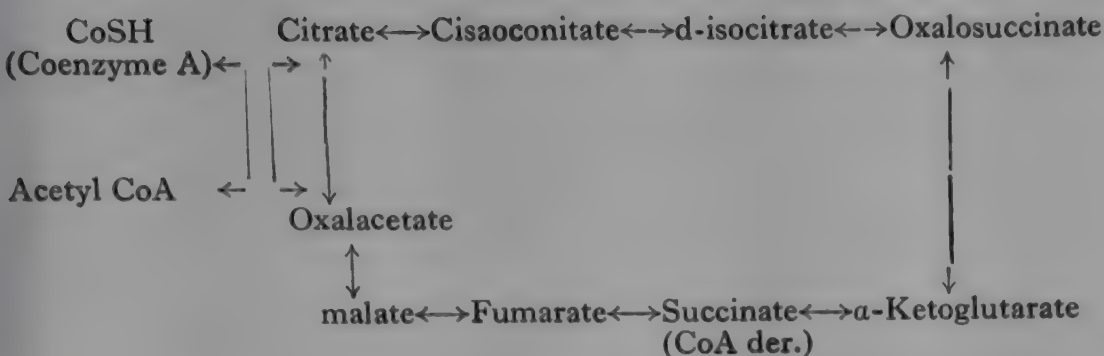
At this stage an important clue to the above argument was supplied by the work of Dr Lipmann. In 1945, he discovered in animal tissues a substance which was essential for acetic acid utilization and named it Coenzyme A (CoA). Lynen isolated this active acetate form—acetyl CoA—from Baker's yeast. There appeared to be a striking similarity between the acetic acid utilization and fatty acid oxidation, and Baker and Stadtman of California were the

first to suggest that the active form of fatty acid, suggested previously might as well be its CoA derivative, similar to acetyl CoA.

Now progress in the field of fatty acid oxidation really got under way. One of the difficulties in the initial stages was availability of CoA in gram quantities. Workers at Wisconsin solved this difficulty by precipitating the compound from yeast extracts as its copper salt along with the copper salt of glutathione. With large quantities of CoA available and a technique developed for preparing mitochondria, where these enzymes are located, workers in Dr Green's laboratory were able to show that the oxidation of fatty acids is carried out in five steps essentially the same way as was suggested by Knoof about fifty years ago but with one major difference, that it was not the free fatty acid that was oxidised but rather its CoA derivative throughout the following five steps:

1. $R.CH_2.CH_2.CH_2.COOH + CoA + ATP$
 $\longrightarrow RCH_2CH_2CH_2CO.S.CoA.$
2. $R.CH_2.CH_2.CH_2CO.S.CoA$
 $\xrightarrow{\text{dehydrogenase}} RCH_2CH = CH.CO.S.CoA$
3. $R.CH_2CH = CH.CO.S.CoA$
 $\xrightarrow{\text{hydrase}} RCH_2CHOH.CH_2.CO.S.CoA$
4. $R.CH_2.CHOH.CH_2CO.S.CoA$
 $\xrightarrow{\beta\text{hydroxyacyl CoA dehydrogenase}} R.CH_2.CO.CH_2CO.S.CoA$
5. $R.CH_2.CO.CH_2CO.S.CoA$
 $+ HSCoA \xrightarrow{\text{cleavage enzyme}} R.CH_2CO.S.CoA + CH_3.CO.S.CoA$

The acetyl CoA in the final step enters the tricarboxylic acid cycle given below and the original fatty acid now with two carbon atoms less, undergoes the same series of reactions until finally completely broken down.



In normal liver, acetyl CoA enters the tricarboxylic acid cycle but under abnormal conditions where the cycle is impaired, two mols. of acetyl CoA condense to give acetoacetyl CoA. If fatty acid synthesis is defective, the acetoacetic goes on accumulating. As there is considerable deacylase activity in liver and a weak acetoacetic activating enzyme activity, free acetoacetic acid accumulates in liver. This is released in blood and its break down products give rise to a condition known as ketosis.

Turning to the fatty acid synthesis at the present although indications are that the same enzymes might be involved as those in oxidation, different experimental conditions are required to carry out the synthesis than those necessary for oxidation. Some of the requirements for *in vitro* synthesis are lipoic acid, coenzyme A, adenosine triphosphate, triphosphopyridine nucleotide, Mg^{++} , Mn^{++} , and glutathione. Further work is indicated before any definite conclusions can be drawn about the complete mechanism of fatty acid synthesis in body.

Mr F. L. Guthals, Entomology Adviser to the Government of India, New Delhi, Mr John Boonlee, Thailand Irrigation Department, Bangkok, Sir Tan Heilboon, London University, Mr Penn, Director of United Breweries, Bombay and Mr Carl G. Blomquist, Consul for Sweden, Madras, visited the Institute on 5-2-1957.

Mr S. Yaha Pontoh, Consul for Indonesia, Bombay and Prof. Buddington, Princeton University, U.S.A., visited the Institute on 7-2-1957.

Dr C. F. Hummel, visiting technologist from M/s. Buhler Bros.,

Switzerland, addressed a special seminar on 8-2-1957 on 'Macaroni products'.

He stated that the macaroni industry which originated about 150 years ago in Italy, has become one of the largest food processing industries in the world. The consumption of macaroni products varies from country to country and according to the statistics available, the figures of annual consumption per capita are as follows: Italy 52-80 lb. Switzerland 15-25 lb. U.S.A. 6-12 lb. Germany 4.6 lb.

Dr Hummel then traced the history of development of macaroni industry from the first indigenous process as practised in Italy to the latest mechanised mode of manufacture. He mentioned that wheat semolina is the most important raw material for the manufacture of macaroni products and for certain products such as noodles, wheat flour is also used. The addition of eggs to macaroni is optional. He pointed out that the most striking developments have been in the design of drying equipment and emphasised that the quality of the finished product depends to a very large extent, not only on the quality of the raw materials, but also on the mode of drying. The short goods are easier to dry as compared to longer ones. The extra cost in drying together with the additional packaging cost is responsible for the long goods being more expensive than short ones. Dr Hummel pointed out that, in as much as the macaroni industry is yet to develop in this country, it would be advisable to confine ourselves in the earlier stages only to short goods. He laid special emphasis on developing macaroni products based on indigenous raw materials and keeping in view the Indian way of

cooking and Indian dietary habits. Dr Hummel commended the approach made by the Institute in developing enriched and fortified macaroni products as he felt that it is a better method of providing a balanced food to the consumers of low income groups. He advised that short goods of two or three types should be made and consumer acceptance tests carried out.

Dr Bhatia then described different types of macaroni products made in different countries. He informed that dies for making macaroni in four different shapes have been received and the products will soon be made available to the staff of the Institute. He described the composition of the enriched macaroni and added that the products have been fortified with calcium and vitamins. He stated that the product stored in jute, cloth or plastic bags has satisfactory storage life. The moisture content of the product is very important and should be within the range of 7-9 per cent.

Dr Parpia, speaking next, stated that in view of the present food situation in the country and the ever increasing population, it would be worthwhile to utilize tuber crops for the manufacture of balanced articles of food.

The Director in his concluding remarks stated that cooked macaroni is easily assimilated and the manufacture of such a product will be an elegant method of introducing wheat into the South Indian dietary. It will thus be possible to give a staple food having much higher protein content than the polished rice. He felt that there is a tremendous scope for popularising the enriched macaroni containing 18 per cent protein. The macaroni products can be used for a variety of dishes with which the South Indian rice eater is familiar. In the end the Director thanked Dr Hummel for his very interesting and educative talk.

Mr M. S. Randhawa, Vice-Chairman, I.C.A.R., visited the

Institute on 9-2-1957 and addressed a special seminar.

Dr K. V. Puttappa, Vice-Chancellor of the Mysore University, visited the Institute on 13-2-1957.

Mr B. V. Parmar, Director, T. L. Elliot and Co., Nairobi, visited the Institute on 15-2-1957.

Dr B. G. Dake, Medical Officer, Civil Hospital, Ahmednagar, visited the Institute on 20-2-1957.

Dr R. Vanciliff, T.C.M. Fisheries Expert to the Ministry of Food and Agriculture, Government of India, New Delhi, Smt. M. Samuel, Ministry of Agriculture, Govt. of India, New Delhi and Dr H. D. R. Iyengar, Fisheries Officer, Government of Mysore, visited the Institute on 23-2-1957.

Tours

Dr T. N. Ramachandra Rao, proceeded on tour on 31-2-1957 to Cannanore and Cochin to attend the Spices and Cashew Exhibition, for technical discussion with the Secretary, Pepper Export Council and also to visit pepper godowns at Cochin.

Dr V. Subrahmanyam proceeded on tour to Delhi on 4-2-1957 to attend a meeting convened by the Indian Council of Agricultural Research to adjudicate the moisture testing apparatus designed by Shri Momin.

Mr Y. S. Lewis proceeded on tour on 6-2-1957 to Bangalore to study the facilities available in the United Breweries Ltd., regarding the manufacture of active dry Baker's yeast.

Mr G. L. Tandon accompanied by students of the Diploma course in Fruit Technology proceeded on tour to Calcutta, Rajhmundry, Madras and Trichur on 7-2-1957.

Dr S. V. Pingale and Mr N. V. R. Iyengar proceeded on tour on 9-2-1957 to Delhi and Jammu in connection with studies on infestation control in walnuts.

Dr V. Subrahmanyam proceeded on tour on 24-2-1957 to Delhi in connection with the meetings of (1) the Biochemical and Vanaspathi Research Advisory Committees, (2) Joint Committee with Ministry of Heavy Industries (Development

wing) and (3) meeting to discuss foreign exchange, cement, steel etc.

Dr H. A. B. Parpia proceeded on tour on 18-2-1957 to Bombay to give evidence before the Tariff Commission in connection with seeking protection to the Fruit Industry and then to Calcutta to discuss matters relating to the Extension Services with the Metal Box Co., of India Ltd.

List of Papers Published

581. **A simple method for the enumeration of Anaerobic Bacteria**, by Sreenivasamurthy, V. and Krishnamurthy, K, *Bull. cent. Food technol. Res. Inst.*, 1956, 5 (14), 334.

582. **Studies on the Nutritive value of Rice and Rice diets, I. The nutritive value of husked, undermilled and milled raw rice**, by Subrahmanyam, V., Narayana Rao, M. and Swaminathan, M. (with statistical evaluation of results by Sankaran, A. N.), *Ann. Biochem. exptl. Med.*, 1956, 16 (2), 81.

583. **Studies on the nutritive value of diets supplemented with galactomannan mucilage of the seeds of caesalpinia pulcherrima Linn.**, by Bains, G.S., Bhatia, D.S. and Subrahmanyam, V., *J. Indian chem. Soc. Industr. Edn.*, 1956, 19, 2.

584. **Acids and sugars in Eugenia jambolana**, by Lewis, Y.S., Dwarakanath, C.T. and Johar D. S., *J. sci. industr. Res.*, 1956, 15C (12), 280.

585. **Studies on the nutritive value of yeast fortified drinks**, by Ramachandra Rao, T.N. and Johar, D.S., *Bull. cent. Food technol. Res. Inst.*, 1956, 5 (15), 353.

586. **Bulk storage of orange squash preserved with sulphur dioxide**, by Siddappa, G.S. and Bhatia, B.S., *Bull. cent. Food technol. Res. Inst.*, 1956, 5 (15), 354.

587. **Present position of research and development work in fruit and vegetable preservation in India**, by Siddappa G.S., *Bull. cent. Food technol. Res. Inst.*, 1956, 5 (15), 355.

588. **Infant nutrition and In-**

fant foods. Part I. The use of Mammalian Milk in the feeding of infants, by Chandrasekhara, M. R., Swaminathan, M. and Subrahmanyam, V., *Indian Dairym.*, 1956, 8 (12), 1.

589. **Breakdown and synthesis of sesamolin in the sesame seed (*Sesamum indicum*)**, by Nagabhushanam, A., Srinivasan, M. and Subrahmanyam, V., *J. sci. industr. Res.*, 1956, 15C (12), 283.

590. **Infant nutrition and Infant foods, Part II. Processed milk foods**, by Chandrasekhara, M.R., Swaminathan, M. and Subrahmanyam, V., *Indian Dairym.* 1957, 9 (1), 1.

Additions to the Library

1. *Miracles of Indian herbs*, 1955, by Verma, G.S., (Rasyan Pharmacy, Delhi), pp. 326. Rs 5-0-0.

2. *Fundamentals of radio valve technique, Book I*, 1949, by Deketh, J., (Philips Elec. Co. Cal.), pp. 535, Rs 18-0-0.

3. *Data and circuits of receiver and amplifier valves*, 1949, (Philips Elec. Co. Cal.), pp. 406, Rs 9-8-0.

4. *Electronic valves, Book III*, 1949, (Philips Elec. Co. Cal.), pp. 213, Rs 8-0-0.

5. *Application of the electronic valve in radio receivers and amplifiers, Vol. I*, 1950, by Dammers, B.G., (Philips Elec. Co. Cal.), pp. 416, Rs 16-8-0.

6. *Electronic valves in A.F. amplifiers*, 1954, by Rodenhuis, E., (Philips Elec. Co. Cal.), pp. 147, Rs 5-0-0.

7. *Electronic valves, Book III. A*, 1952, by Markus, N.S., and Otte, J., (Philips Elec. Co. Cal.), pp. 487, Rs 18-8-0.

8. *Proceedings of the IXth International Congress of Refrigeration Vols., I and II*, 1955, (Comite du IXth Congress International du Froid. Paris), Rs 143-0-0.

9. *An introduction to public library organization*, 1955, by Viswanathan, C.G., (Asia Pub. House, Bom.), pp. 152, Rs 7-8-0.

10. *Establishing optimum conditions for storage and handling of semiperishable subsistence items*, 1955 (Food Container Inst. Chicago), pp. 130.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

Tetrabromide method for estimating linoleic acid in fatty acid mixtures, by Phatak, K.D. and Aggarwal, J.S., *J. sci. industr. Res.*, 1957, **16B** (1), 19.—The determination of linoleic acid in fatty acid mixtures can be carried out on the basis of the tetrabromide value of the mixtures determined under controlled experimental conditions. When linolenic acid is present in the mixture, the ethyl ether insoluble hexa-bromostearic acid has to be removed from the brominated fatty acids prior to the separation of tetrabromides.

A new universal indicator for acid-base titration, by Buddhadev Sen, Eugene Berg and West, P.W., *Sci. & Cult.*, 1957, **22** (8), 457.—Iron forms a complex with 1, 2-dihydroxy-benzene-3, 5-disulfonic acid and the AA have found that the region of maximum absorption of this colour system changes rapidly at three different pH ranges. The colour changes from greenish blue to deep blue between pH 2.6 and pH 4, from deep blue to deep violet between pH 5.1 and pH 6.3 and from violet to brown at about pH 10. All these changes are dependent on pH and also are reversible. The colour change from deep blue to violet is very sharp and the pH range 5.1 to 6.3 over which the above change takes place is in the middle of the region of inflection in the titration of strong acid against a strong base. The complex can, therefore, be used as an indicator for the above titration without any error at all. The colour changes of the complex at other pH ranges fall in the pH change regions of weak acid-strong base and strong acid-weak base titrations. When the complex was used as an indicator in such

titrations, there was always some error. The indicator solution is prepared by dissolving 0.05 mole of iron (ferric ammonium sulphate) and 0.15 mole of the sodium salt of the reagent separately in water and then mixing. The solution is filtered and diluted to one litre.

K.L.R.

Behaviour of reductone in ascorbic acid estimation, by Sivarama Sastry, K. and Sarma, P.S., *Curr. Sci.*, 1957, **26** (2), 52.—The presence of reductones which occur in food products is known to interfere with the estimation of ascorbic acid by the usual standard methods, viz., the 2:6-dichlorophenol indophenol (titration) procedure and the 2:4-dinitrophenyl hydrazine (colorimetric) method. The AA of this note have made a comparative study of the two methods with solutions of reductone prepared from glucose with a view to find out the best of the procedures. It is found from the values of ascorbic equivalents of gluco-reductone assayed according to the two procedures, that the colorimetric method is very much more susceptible to interference. The AA suggest, therefore, that the titration procedure in presence of formaldehyde to eliminate the interference of reductones should be adopted for the estimation of ascorbic acid in samples containing large amounts of reductones.

K.L.R.

Sodium and potassium contents of Indian foodstuffs, Pain, S.K. and Banerjee, S., *Indian J. med. Res.*, 1956, **44**, 749.—Sodium and potassium contents of foodstuffs commonly consumed in this country were estimated. Out of different foodstuffs, soyabean, mung dal (amongst pulses); whole wheat, ata (amongst cereals); green

plantain, and sweet potato (amongst vegetables); prawn, and Rohu fish (amongst fishes); duck's egg yolk and hen's egg yolk; beef and goat's muscle; goat's liver; and skim milk are good sources of potassium. Soyabean, mung dal (amongst pulses); whole wheat and ata (amongst cereals); beef and goat's muscle; goat's liver; prawn, bhekti (amongst fishes); green plantain and potato (amongst vegetables); duck's egg yolk and hen's egg yolk; and skim milk are rich sources of sodium.

M.N.

BIOCHEMISTRY AND NUTRITION

Physico-chemical investigations on indigenous seed proteins: Part I—Studies on the solubilization of nitrogenous constituents of *Sesamum indicus* and characterization of its proteins by electrophoresis, by Ravindra Nath and Giri, K.V., *J. sci. industr. Res.*, 1957, **16C** (1), 5.—Optimum conditions for the extraction of proteins from sesamum seed meal have been determined employing 10 per cent sodium chloride solution. Electrophoretic studies carried out with the seed proteins in the pH range 6.4-8.0 and ionic strength of 0.1 revealed the presence of one major and three minor protein components.

Amino acid composition of cashew-nut globulin, by Subramanian, N., Lakshminarayana Rao, M.V. and Srinivasan, M., *J. sci. industr. Res.*, 1957, **16C** (1), 24.—The results of ten paper chromatographic analysis of the globulin ('Anacardein') isolated from cashew-nut are presented in this note. 16 amino acids and their amounts present in 100 g. of the protein are given in a table.

Values for proline and tryptophan are to be reported later.

K.L.R.

Studies on the nutritive value of rice and rice diets, I. The nutritive value of husked, undermilled and milled raw rice, by Subrahmanyam, V., Narayana Rao, M. and Swaminathan, M., *Ann. Biochem. exptl. Med.*, 1956, **16** (2), 81.—Raw husked rice, raw undermilled rice containing 1.8 μ g. thiamine per gram and raw milled rice prepared from the same lot of paddy were analyzed for proximate principles, calcium, phosphorus, iron, thiamine and niacin.

No significant difference was observed in the growth-promoting value of husked, undermilled and milled rice when they were incorporated at 94 per cent level in diets containing fat and vitamins A and D and when they constituted the only source of proteins, B-vitamins and minerals in the diets; but when the above diets were supplemented with calcium, husked rice promoted a significantly higher growth-rate than raw undermilled or milled rice. The superior growth-promoting value of husked rice was found to be due to its higher B-vitamin content.

The growth-promoting value of the poor vegetarian diets containing husked rice or undermilled rice were significantly higher than that of the diet containing raw milled rice. When the above diets were supplemented with calcium, an increase in the growth-promoting value of all the three diets was observed.

No significant difference in the retention of calcium was observed among the three groups of rats fed on poor vegetarian diets containing the different samples of rice.

A study on urease, Part I. Extraction of active urease, by Nath, R.L. and Ullah, R., *Ann. Biochem. exptl. Med.*, 1956, **16** (2), 89.—A highly active preparation of urease was obtained from *Cajanus indicus* and the optimum volume of solvent required for its precipitation was determined.

Extraction of the enzyme at the optimum pH did not improve the activity.

Purification of the enzyme by reprecipitation with acetone was not of much advantage.

Free amino-acids in Erythrocytes in diabetes mellitus, by Iyer, G. Y. N., *Curr. Sci.*, 1957, **26** (2), 60.—The A has studied the effect of diabetes mellitus on the levels of free amino acids in red cells in 20 patients. The amino acids have been estimated by paper chromatographic procedure. The observed range, mean and standard deviation for the concentration of the different amino acids as also the corresponding normal values are given in a table. There is a marked lowering in the concentration of aspartic acid and glutamine in diabetics while the levels of the rest viz., alanine, glutamic acid, glycine, serine, valine, leucine and isoleucine are not appreciably affected.

K.L.R.

Studies on experimental diabetes, by Mukherjee, S.K. *et al*, *Indian J. med. Res.*, 1956, **44**, 415.—In alloxan diabetic animals, at the end of 18 hours after alloxan administration, lowering of phosphatase activity of kidney and serum, increase in phosphatase activity of liver, and no change of pancreatic phosphatase activity was observed. By the end of 7 days, kidney phosphatase activity approaches normal level and serum phosphatase activity exceeds the normal level. No change was observed in the pancreatic phosphatic activity even after 7 days.

M.N.R.

Haematological changes in nutritional oedema syndrome (Kwashiorker), by Mehta, G. and Gopalan, G., *Indian J. med. Res.*, 1956, **44**, 727.—Haematological changes in 18 cases of kwashiorker were investigated. It was found that anaemia in kwashiorker may arise from deficiency of protein, iron or liver principle. The pace of improvement in all cases was slow. Obviously, in the evolution of the anaemias both deficient

supply as well as defective utilization of the concerned nutrients play a part. Cases of kwashiorker treated for a few weeks exhibited eosinophilia. Pronounced depression of gastric acid secretion was observed in all cases on admission. After high protein-diet therapy, gastric acid secretion tended to return to normal levels.

M.N.R.

Studies in experimental atherosclerosis, by Chakravati, R.N. *et al*, *Indian J. med. Res.*, 1956, **44**, 677.—Experimental atherosclerosis was produced in rabbits by prolonged cholesterol feeding for twelve weeks. Atherosclerotic rabbits showed impairment of liver functions as evidenced by increase in serum cholesterol and its fractions, C:P/ratio, globulin with reversal of albumen and globulin ratio and thymol turbidity. The serum alkaline phosphatase was markedly lowered. Carbohydrate and bile metabolism were unaffected. A possible correlation between liver derangement and the initiation of the atherosclerotic syndrome has been postulated.

M.N.R.

Production of experimental glycosuria in rabbits, by intraperitoneal injection of glucose, by Banerjee, S. and Sarkar, A.M., *Indian J. med. Res.*, 1956, **44**, 667.—The glucose tolerance of partially pancreatectomized rabbits progressively diminished as they received injections of glucose. They also excreted sugar and acetone bodies in urine. The pancreas showed increased number of alpha cells in the islets of langerhans without any changes in the beta cells. Hyperglycemia, glycosuria and acetonuria observed in these rabbits may be due to the increased formation of hyperglycemic factor by the alpha cells of the islets of langerhans.

M.N.R.

COFFEE

Adulteration of coffee and its detection, by Subrahmanyam, V., Bhatia, D.S. and Natarajan, C.P., *Indian Coffee*, 1957, **21** (1), 8.—The genesis of the problem of adulteration in coffee is owing to

the fact that coffee is very expensive and available in limited quantities, while the adulterants are cheap and abundantly available. Substances used for adulterating coffee have been listed. The most common ones used in India are date seed, tamarind seed and shell, tapioca chips and skin, cherry husk and chicory. The methods of detecting adulteration both qualitatively and quantitatively based on the differences in the microscopic structure and chemical composition of pure coffee and the adulterants are described. Data on the tentative standards for Indian coffee, chemical composition of some pure adulterants and blends of coffee with the adulterants are given in tables and these help to detect adulteration in coffee. The problem can also be approached through the determination of specific chemical constituents like inulin, starch, simple sugars and tannin like constituents (i.e. chlorogenic acid) which may be characteristic of either coffee or the adulterants. The AA have reported a simple qualitative test for detecting the presence of date and tamarind seed particles in coffee based on the fact that coffee gives a yellow colour with 2 per cent alkali while date and tamarind seeds give reddish and pink coloration respectively. The test is fool-proof above 10 per cent level of adulteration and over-roasting of the powder or storage does not affect the sensitivity of the test.

K.L.R.

FRUIT AND VEGETABLE PRODUCTS

Effect of storage on the nutrients of badami and raspuri mangoes, by Andrabi, M.H., Magar, N.G., Pruthi, J.S. and Lal, G., *Indian Food Packer*, 1956, 10 (11), 9.—Canned mangoes stored at 43°C, 37°C and at room temperature were cut opened for the analysis of the various materials before and after storage.

The rate of hydrolysis of invert sugar at all storage temperatures were very fast during the first half of the storage period. The dis-

coloration was highest at higher temperatures. Similarly they have reported that the destruction of ascorbic acid was more during the first half of the storage period which was concluded due to the presence of residual oxygen inside the can.

The retention of carotene upto 12 months storage was quite fair even at 43°C. After 18 months storage at 43°C, 50 per cent carotene was retained. Badami mangoes showed better retention of carotene as compared to Raspuri variety in all temperatures. The other vitamins, viz., thiamine, riboflavin and nicotinic acid were not affected appreciably by canned mangoes at three different temperatures.

Spoilage of cans due to corrosion were observed after six months stored at 43°C. The taste of mangoes showed a sort of cooked flavour and disintegration of slices stored at 43°C. The corrosion was less when stored at lower temperature.

C.M.P.

INSECTICIDES

Resistance of some species of coleopterous store insects to chemical treatment, by Sheshagiri Rao, D., *Curr. Sci.*, 1957, 26 (2), 54.—Earlier work on the extent of mortality of the common beetle pests of stored grains with 0.025 to 0.1 per cent solution of D.D.T. in kerosene oil has shown that the insects in the decreasing order of susceptibility are: *Bruchus*, *Sitophilus*, *Rhizopertha*, *Tribolium* and *Latheticus*. It is also shown that the dosage of insecticide required is to be adjusted according to the weight of the insects concerned. With a view to throw more light on this aspect, the A has collected 100 adult insects of the different species and their dry weight determined after starving them for 24 hours and then drying in an oven at 100°C for a week. The results definitely show that the order of susceptibility is the same as given above except in the case of *Tribolium*. Heavier species are less resistant than lighter ones. The other conclusions drawn by the A are (i) the bigger

insects are proportionately heavier than the smaller ones, (ii) there is no correlation between the proportion of dry matter and water-content on the one hand and resistance on the other and (iii) the loss in weight after 24 hours starvation with reference to the body weight or the water-content conforms to the order of resistance of the insects.

K.L.R.

MICROBIOLOGY

Studies on the nitrogen utilization by a *Pseudomonas* species during the synthesis of riboflavin, by Majumdar, (Miss) N., Maitra, P.K., Ganguly, S. and Roy, S.C., *Ann. Biochem. exptl. Med.*, 1956, 16 (2), 105.—The utilization of nitrogen source in the form of total, amino, and ammonia nitrogen by a *Pseudomonas* sp. for its synthesis of riboflavin in a casein-hydrolyzate medium has been studied.

Amino acids utilized from the medium and also reflected in the composition of the bacterial cells have been determined by the paper chromatographic technique.

On the nature of growth inhibition of *Escherichia coli* by an oxidation product of vitamin B₁₂, by Alimchandani, H.R. and Sreenivasan, A., *Proc. Indian Aca. Sci.*, 1957, 45 (1), 21.—Earlier workers had shown that an oxidation product of vitamin B₁₂ acted as air antagonist of this vitamin to micro-organisms under certain conditions. The AA have shown that the oxidation product at a concentration equivalent to 30 µg. B₁₂/10 ml. completely inhibits the growth of *E. coli* which cannot be reversed by vitamin B₁₂. p-aminobenzoic acid which is functionally related to Vitamin B₁₂ and the metabolites in whose synthesis the former is involved were all found to be ineffective in reversing the growth inhibition. However, yeast extract, peptone or the extract of crushed cells of *E. coli* showed considerable activity in overcoming the growth inhibition of the oxidation product. Experiments with mixtures of amino acids,

purines and pyrimidines and vitamins of the B group showed that only the amino acid mixture could check the growth inhibition though only partially. This indicates that the oxidation product functions by inhibiting the synthesis of amino acids. It was, however, noted that the amino acids when used individually had no effect thus suggesting that the biosynthesis of more than one amino acid was blocked by the antagonist.

K.L.R.

A preliminary study of the Fungus flora of kanji, by Manorama Mahapatra, *et al.*, *Sci. & Cult.*, 1957, **22** (8), 457.—*Kanji* is a common liquid diet which is used in many parts of India. The method of preparation of *kanji* is described. The basic source for this preparation is *Torani*, a product which is prepared from cooked rice and allowed to ferment for a few days before being used for cooking with vegetables to give *kanji*. The AA have investigated the nature of the fungus flora present in the *Torani* during the period of fermentation. Microscopic study of the liquid revealed yeast-like organisms on the 2nd day and on the 5th day, fungal mycelium was visible. The pure species have been isolated by the method of dilution. 41 isolates were obtained of which 21 belonged to yeast and the remaining 20 to moulds. The names of the fungi identified in these 20 isolates have been given. The identity of 21 isolates of the yeast category is under investigation. The fungus flora of *Torani* is mostly due to the exposure of the dilute rice starch to natural infection by microorganisms capable of growing in the medium. The method of preparation is such that the chance of contamination is very high and as such some of the flora are simply contaminations and may have no relation with the fermenta-

tion of *Torani*. Studies to ascertain the biochemical activities of the isolated organisms are under progress.

K.L.R.

OILS AND FATS

Component fatty acids of hydrogenated fats and their stability, by Patil, V.S. and Magar, N.G., *J. sci. industr. Res.*, 1957, **16B** (1), 43.—The fatty acid compositions and stabilities of seven samples of vanaspati have been determined. The data show that the stabilities of hydrogenated fats can be correlated with the extent and nature of the fatty acids present in them.

Application of conversion factors for the determination of vitamin A in fish liver oils, by Balasundaram, S., Cama, H.R., Sundaresan, P.R. and Varma, T.N.R., *J. sci. industr. Res.*, 1957, **16C** (1), 8.—The application of conversion factors in the spectrophotometric determination of the vitamin A potency of fish liver oils on the basis of gross and corrected $E_{1\text{ cm}}^{1\%}$ values at 328 $m\mu$ and $E_{1\text{ cm}}^{1\%}$ value at 290 $m\mu$ has been tested with fresh and stored oils. Oxidation of vitamin A in fish liver oils does not seem to alter the $E_{1\text{ cm}}^{1\%}$ value at 290 $m\mu$. The vitamin A potency of stored oil determined on the basis of $E_{1\text{ cm}}^{1\%}$ value at 290 $m\mu$, therefore, helps in assessing the original potency of the oil.

GENERAL

Studies on iso-oleic acids: Part IV—Urea complexes for the segregation of iso-oleic acid fractions, by Mahadevan, A.P. and Subbaram, M.R., *J. sci. industr.*

Res., 1957, **16B** (1), 15.—Fractions rich in iso-oleic acids have been obtained from the mixed fatty acids of vanaspati and beef body fat by fractional crystallization of the urea adducts from methanol. The enrichment effected compares favourably with that resulting from the lead salt separation. In order to keep the crystallization steps to the minimum, the mercuric salt fractionation was used for separation of the mixture of saturated and *trans* unsaturated acids.

The aldobiouronic acid from groundnut shell hemicellulose A₁, by Radhakrishna Murthy, B. and Srinivasan, V.R., *Curr. Sci.*, 1957, **26** (2), 50.—Hydrolysis of the groundnut shell hemicellulose A₁ with dilute acid yields a mixture of an aldobiouronic acid, d-xylose, and a small quantity of l-arabinose. The acidic component has been separated and its composition has been studied in detail by the AA. The acid is made up of d-glucuronic acid and d-xylose as shown by paper chromatography and the two are linked together at the C₂ position of the d-xylose molecule. The configuration of the aldobiouronic acid has been given and it is 2-o-(d-glucuronosyl)-d-xylose. The observed equivalent weight (314) is in agreement with the formula given.

Studies on the use of sorbic acid in foods, Paper by courtesy of CHAS PFIZER & CO., Inc., New York, *Indian Food Packer*, 1956, **10**, 11.—A paper dealing with the studies of the use of sorbic acid in foods has been reviewed. The use of sorbic acid in various products like cheese and cheese products, pickles, fish products, carbonated beverages, margarine and some other miscellaneous foods, is included in the review.

C.M.P.

PART II (Foreign)

ANALYTICAL

Quantitative determination of reducing sugars and sucrose separated by paper chromatography, by Shallenberger, R.S. and Moores, R.G., *Anal. Chem.*, 1957, **29** (1), 27.—An objective method for determining reducing sugars and sucrose separated by paper chromatography uses a simplified elution procedure and requires no special device. Corrections for interference due to the filter paper requires only the determination of interference given by a standard sized piece of filter paper. Sucrose is determined after hydrolysis with invertase. The standard deviation is less than 5% in the range from 10 to 200 % of sugar. The method is recommended for the routine determination of sugars in plants and foods.

Quantitative chromatographic procedure for determining dextrose in sugar mixtures, by Emma McDonald, J., *Anal. Chem.*, 1957, **29** (1), 32.—Dextrose can be transferred from a paper chromatogram to glass fiber paper and the sugar subsequently determined in the presence of the glass fiber. Results are given for the procedure as applied to the determination of dextrose in honey.

Factors influencing validity and confidence limits of pantothenic acid estimation—Microbiological assay with *Lactobacillus Casei*, by Miriam Clarke, F., *Anal. Chem.*, 1957, **29** (1), 135.—Earlier work had demonstrated a linear relationship between the logarithm of pantothenate per tube and the amount of acid formed upon incubation with *L. casei*, provided glucose was increased in the medium to a level that would eliminate it as a limiting factor. Now a change in the media from peptone to enzymehydrolysed casein yields a straight line but with a much greater slope. Factors affecting the slope of this logarithmic dose-response curve were ex-

amined critically: glucose content of the medium, size and method of preparation of the inoculum. Most favourable conditions for valid assays were found when 3 per cent glucose and heavier inoculum (from enriched medium) were employed and when dosage corresponded to 0.125 to 0.25 % of calcium pantothenate. Under these conditions, the slope of the dose-response curves was between 13 and 18, and assays of 2×2 or 2×3 design, using 16 or 18 tubes, yielded confidence limits of 98 to 102 per cent.

A micro method for the separation and determination of Polysaccharides by zone electrophoresis, by Fuller, K.W. and Northcote, D.H., *Biochem. J.*, 1956, **64** (4), 657.—A zone electrophoretic method for the quantitative separation of neutral polysaccharides is described. The strip support used is silk and the method gives 85 per cent recovery of a four-component mixture containing 100 µg. of each component. A qualitative zone-electrophoretic method with glass paper as a support and *p*-anisidine as a general spray reagent is described. The electrophoretic movement of the neutral polysaccharides used is dependent upon the use of borate buffer.

The spectrophotofluorometric determination of tryptophan in plasma and of tryptophan and tyrosine in protein hydrolysates, by Duggan, D.E. and Udenfriends, J., *J. biol. Chem.* 1956, **223** (1), 313.—Ultraviolet fluorescent spectra of tryptophan and tyrosine have been used for the determination of these amino acids in protein hydrolysates. A spectrophotofluorometric method for the determination of free tryptophan in plasma is described. Levels of plasma tryptophan in normal fasting subjects were determined and found to be in good agreement with the results of microbiological determinations cited by other workers.

BIOCHEMISTRY AND NUTRITION

Missing step in guinea pigs required for the biosynthesis of L-Ascorbic acid, by Burns, J.J., Pincus Peyser and Arnold Moltz. *Science*, 1956, **124**, 1148.—Guinea pigs are not able to synthesise L-ascorbic acid in the body. The present note deals with the possible explanation given by the authors. It has been shown by many workers that the formation of L-ascorbic acid in the rat follows the pathway; D-glucose → D-glucuronolactone → L-gulonolactone → L-ascorbic acid. The AA have compared the role of L-gulonolactone as a precursor for L-ascorbic acid biosynthesis in rats and guinea pigs. Appreciable conversion of L-gulonolactone to L-ascorbic acid was found in rats while no conversion was detected in guinea pigs. *In Vitro* experiment also showed good synthesis of L-ascorbic acid from L-gulonolactone in homogenates of rat liver but none in those of the guinea pig. No activity was detected either in the microsomes or mitochondria of the liver of the pig unlike in the rat. The fact that microsomes of the guinea pig liver cannot convert L-gulonolactone to L-ascorbic acid indicates the possibility of some biochemical step needed for the synthesis, missing in this species.

K.L.R.

The metabolism of butylated hydroxyanisole in the rabbit, by Dacre, J.C., Denz, F.A. and Kennedy, T.H., *Biochem. J.*, 1956, **64** (4), 777.—The metabolism of the antioxidant, butylated hydroxyanisole (BHA), and of its component isomers, 2- and 3-*tert*.-butyl-4-methoxyphenol has been studied in the rabbit. After 1 g. of BHA by mouth, rabbits excreted 46 per cent as glucuronides, 9 per cent as ethereal sulphates and 6 per cent as free phenols. The recovery of glucuronide was 60 per cent of a 0.5 g. dose, and 84 per cent of a 0.25 g. dose. After repeated doses of 1 and 0.5 g., recovery of BHA as glucuronide was

lower than after single doses. The glucuronides of the two BHA isomers have been isolated from the urine as barium (2-*tert.*-butyl-4-methoxyphenyl glucosid)-uronate and barium (3-*tert.*-butyl-4-methoxyphenyl glucosid)-uronate BHA is unstable on heating in 5N-HCl and breaks down to *tert.*-butylquinol, p-methoxyphenol and quinol. Hydrolysis of 2-*tert.*-butyl-4-methoxyphenyl glucosiduronic acid with 5N-HCl results in the destruction of at least half of the 2-*tert.*-butyl-4-methoxyphenol and the production of more than a dozen other phenolic compounds.

COFFEE

Progress in spray drying, by Metcalfe, L.S., *Coff. & Tea Industr.*, 1956, **79** (12), 28.—In this general article, the A deals with the advance made in the equipment design for spray drying of solutions with particular reference to coffee extract. The process of drying coffee extract has been described briefly and this helps to preserve the special flavour of good coffee. With improved spray drying equipment and techniques, other processes like denitration, spray chilling and blending can be carried out in the same operation. By using the modern spray dryer, operations such as crystallization, secondary drying activities, grinding, screening, and classification of materials can be deleted and thus reduce the cost. The heating elements used, the method of atomising the fluid and the drying of the powder particles with hot air mixed with 2 or 3 per cent combustion products are given. The advantages, the quickness and the continuous nature of the spray drying process have been stressed.

K.L.R.

DAIRY PRODUCTS

Observations on the thermal inactivation of the organism of Q Fever in Milk, by Enright, J.B., *et al.*, *J. Milk & Food Tech.*, 1956, **19** (11), 313.—Q Fever is an infectious disease of man. Cattle, sheep and goats, who for the most part suffer inapparent infections with the organism, are the important

sources of infection for man. These animals shed the organism in their milk.

This manuscript reports on the co-operative studies designed to determine the times and temperatures needed to eliminate the causative rickettsiae, *Coxiella burnetii*, from cow's milk. It is reported that the present minimum standard pasteurization by the vat method of 143°F. for 30 minutes is inadequate, but the temperature of 145°F. for 30 minutes will eliminate the organism. The pasteurization of milk according to the present standards for HTST equipment of 161°F. for 15 seconds seems adequate to destroy *C. burnetii*.

Rapid calculation of logarithmic average bacterial counts of Milk, by John Schilling, C., *J. Milk & Food Tech.*, 1956, **19** (11), 319.—Determination of logarithmic averages of bacterial counts is a necessary and laborious task in grading raw and pasteurized milk. As the plate count determination replaces the methylene blue test for the ever increasing number of bulk milk producers, the problem becomes greater. A slide rule type of device has been developed that may materially simplify this task. This method is explained with information relative to its principle, application, accuracy and advantages.

Methyl sulphide and the flavour of milk, by Patton, S., Forss, D. A. and Day, E. A., *J. Dairy Sci.*, 1956, **39** (10), 1469.—Normal milk has a faint characteristic flavour. Although the specific compounds responsible for this flavour have not been identified, it is presumed to be due to a mixture of lower fatty acids, 'acetone bodies' and other volatile products. In this note, the AA have established that methyl sulphide ($\text{CH}_3)_2\text{S}$, b.p. 38°C, is present in milk. This was isolated by passing the exhaust gases from an air-agitated cold wall tank of raw whole milk through various trapping solutions. A 1 per cent aqueous solution of HgCl_2 was used to absorb methyl sulphide

and the resulting solution when treated with 1 N HCl gave out a gas whose odour was identical with that of methyl sulphide. This was further confirmed by vapour phase chromatography and also by converting the methyl sulphide into a solid derivative, *viz.*, sulphone (m.p. 110°C) the ether extract of which has three primary absorption maxima. Slightly more than a threshold concentration of approximately 12 p.p. billion of methylsulphide in distilled water imparted a milk-like flavour and much above that concentration the flavour was malty or cowy.

K.L.R.

FRUIT AND VEGETABLE PRODUCTS

Biosynthesis of citric acid in citrus fruits, by Sekhara Verma, T.N. and Ramakrishnan, C.V., *Nature*, 1956, **178**, 1358.—As a preliminary to their study on the biosynthesis of citric acid in citrus fruits (*citrus acida*), the AA have located the stage during the growth of citrus fruit at which citric acid can be detected. Fruit buds of 0.4 cm. diameter were chosen for the experiment and the free acidity and citric acid content of the fruits at different stages of their growth were determined. Results showed that both free acidity and citric acid increased with the increase in the diameter of the fruit. Unidimensional chromatographic analysis of the concentrated samples of the filtrates of the fruits at different stages of growth showed that citric acid with small amounts of malic acid was the predominant organic acid present in fruits of 1.5 cm. diameter and more while at younger stages of growth, the fruits contained mostly succinic acid with small quantities of two other acids still to be identified. Results show that the fruit tissues are completely different regarding the formation and accumulation of citric acid from the tissues of the leaves or stems where citric acid is detected at all stages of growth.

K.L.R.

Non-enzymic browning: the reaction between D-Glucose

and Glycine in the 'Dry' state, by Richards, E.L., *Biochem. J.* 1956, **64** (4), 639.—The reaction between D-glucose and glycine in the 'dry' state at 37°C, pH 6.7 and 70 per cent relative humidity has been studied chromatographically and spectroscopically. An intermediate appeared which gave the colour reactions of both a sugar and an amino acid.

The intermediate has been isolated chromatographically pure from the reaction mixture by displacement chromatography on an ion-exchange resin. It is very strongly reducing but it is not a ketose. Glucosazone can be formed from it. On oxidation with sodium metaperiodate it released three molecular proportions of formic acid and also formaldehyde. On treatment with acid it gave 5-hydroxymethylfurfuraldehyde and glycine.

The infra-red spectrum of the sodium salt of the intermediate is consistent with that expected for the sodium salt of the enolic form of N-(carboxymethyl) amino-1-deoxyfructose.

On this evidence the intermediate has been formulated as the enolic form of N-(carboxymethyl)-amino-1-deoxyfructose, with the tautomeric equilibrium completely in favour of the enol.

The compound has been shown to be a true intermediate in the 'browning' reaction.

INSECTICIDES

Stability of grain as a factor influencing the oviposition rate of the grain weevil *Calandra granaria* (L), by Combs, C.W., *Bull. Entomol. Res.*, 1956, **47**, 737.—In an earlier experiment, it was seen that the weevils laid more eggs on a small bulk of grain than they did when isolated with individual grains. The present paper is an account of the experiments conducted to determine whether stability was the only operative factor. Either fixed or loose grain was presented to the insect for Oviposition. A significantly greater number of eggs was laid upon grain that was fixed. The grains that were

in rows and partially enclosed when in cracks had no greater effect than fixing with gum. Also, there was no significant departure from a random distribution of eggs in grains when the latter were in cracks.

S.V.P.

Responses of pests to fumigation-VI. Water losses and mortality of *Calandra Spp.* at reduced pressures, by Bhambhani, H.J., *Bull. Entomol. Res.*, 1956, **47**, 749.—Experiments are carried out to correlate water loss and mortality in *Calandra granaria* L. and *C. oryzae* L. under reduced pressures. The mortality in both species is shown to be associated with the loss of water. Substantially linear relations were observed between water loss and decreasing relative humidity, increasing period of exposure and decreasing pressure. At lower pressures the water loss and mortality of both species were greatly reduced, suggesting that some physical change had occurred in the insects. A covariance analysis of the mortality response with the loss of water as a concomital variate, showed that there was no significant part of the mortality that was not accounted for by the water loss from the insects.

S.V.P.

The persistence and toxicity of insecticides under tropical conditions, by Duerden, J.C., *et al.*, *Bull. Entomol. Res.*, 1956, **47**, 797.—The persistence and toxicity to *Tribolium castaneum* of initial deposits approximating to 10, 20, and 40 mg. per sq. ft. of γ BHC were studied over a period of 3 weeks in a typical warehouse in Kario, Northern Nigeria. Chemical and biological assessments indicated that the lowest rate of application was inadequate for practical insect control whilst the other two rates showed very similar biological activity upto 8 days after treatment. Thereafter small quantities persisted from application at the highest rate for a further week but the resultant mortalities were inadequate for purposes of field control. It was concluded that to maintain

control of *T. castaneum*, weekly applications of BHC would be required and that the rate of application should approximate to 20 mg. per sq. ft.

Residual soil insecticides for the control of wire worms affecting vegetable crops, by Lange, W.H. and Carlson, E.C., *Hilgardia*, 1956 **26**, 60.—Trials with different insecticides are carried out during 1947-53 and a dosage range is suggested. Periods for which each will remain effective is also predicted. In general lower rates are suggested for light soils and the heavier rates for heavy soils. The choice of the chemical is stated to be determined by the crop to follow. BHC and lindane cannot be used prior to planting a root crop. Also DDT and Dieldrin are slow acting and usually have to be applied several months prior to the time when protection of a crop is needed.

S.V.P.

Effects of soil insecticides on flavour of vegetable crops, by Hinreiner, E. and Simone, M., *Hilgardia*, 1956, **26**, 76.—It is pointed out that many variables involved in an experiment of this kind make it impossible to conclude from the data, precisely which dosage levels of a given insecticide are safe. The experimenter can only consider the average performance of an insecticide as a basis for predicting its tendency to cause off-flavour problems.

BHC even at low levels of $\frac{1}{2}$ lb./acre caused severe off-flavour in canned carrots and sweet potatoes. The off-flavours were less intense in fresh vegetables. Lindane also caused off-flavours in canned vegetables. BHC when applied to soil did affect flavour of carrots even in the 2nd year but lindane was relatively better in the 2nd year.

Aldrin, dieldrin, DDT and parathion treatments produced no significant difference in flavour. Endrin also did not produce any effect but isodrin treated potatoes and carrots, fresh and canned, had a detectably different flavour to the panel. In chlordane and heptach-

lor treated soils, products grown developed slight off-flavour after storage as canned product for 6 months. The intensity of flavour-difference did not however, appear to be serious enough to warrant much concern.

S.V.P.

Photography in Plant and Disease Control, by Cadwallader, Clive, *Discovery*, 1956, **17**, 370.—It is extremely important that producers of food recognise easy signs of pest attacks and disease so that they may take action before damage is irreparable. Photography is a useful aid in this direction. It is stated that during the past 5 years Shell Photographic Unit has made a unique study of the important pests and diseases in the British Isles and throughout the tropical and sub-tropical zones.

Problems relating to magnification, response of insects to heat of studio lighting, anaesthetising of insects and evaporation of body moisture which renders the subject useless, are mentioned and solutions suggested.

S.V.P.

The effect of methyl bromide on the respiration of the cadelle, (*Tenebroides mauritonicus* (L)), by Bond, E.J., *Canad. J. Zool.*, 1956, **34**, 405-415.—A method has been developed for studying the respiration rate of an insect during fumigation, and this method has been used to determine the effect of a common fumigant, methyl bromide, on the respiration of the cadelle. The relation of respiratory rate to the susceptibility of individual larva and the effect of sublethal concentration on the respiratory exchange were also determined. It is shown that the susceptibility of individual cadelles is correlated with their rates of oxygen consumption. Protective stupefaction is also found to be lacking in the cadelle. Furthermore, *T. mauritonicus* has differed from *Tribolium*, *Sitophilus* and *Musca* in being paralysed during fumigation by methyl bromide. The A. concludes that various insects respond to

insecticides in different ways and that observations on a number of species are required to provide a full understanding of insecticidal action.

S.V.P.

OILS AND FATS

A comparative study of the nutritive value of thermally oxidized oils, by Johnson, O.C., *et al.*, *J. Amer. Oil Chem. Soc.*, 1956, **33**, 433.—Effects of feeding thermally oxidized oil (200°, 24 hours) were compared with fresh oil. Butterfat, margarine base-stock, and corn oil were oxidized by blowing air through them at 200° for about 24 hours. The oils so treated showed a reduction in iodine value and increase in Free Fatty Acid and peroxide value. These oxidized oils and the fresh oils were fed in diets containing 20 per cent fat and 31 per cent protein. The results showed that oxidized corn oil had definite growth depressing characteristics. Margarine base showed only a small difference between the fresh and the oxidized samples, and butterfat showed no difference at all.

S.S.K.

New integrated refining process for edible oils, by Cavanagh, G.C., *J. Amer. Oil Chem. Soc.*, 1956, **33**, 528.—The process integrates the different operations normally carried out in different plants from the stage of the cottonseed up to the storage of packed salad oil. The various steps are (i) pre-pressing of cottonseed, (ii) solvent extraction, (iii) recovery of oil, (iv) refining of oil, (v) Winterization, and (vi) deodorization. The integration consists in (i) treating the meals with alkali so as to produce partial refining of oil and a non-dust cake-meal, (ii) refining of oil in miscella to reduce refining loss, increase plant capacity (on account of the very much lower viscosity and greater differences in specific gravity between the two phases) and avoiding gummy deposits in desolventizing stills and crude oil storage tanks, (iii) Winterization of miscella, to reduce

winterizing troubles on account of continuous operations without filtration, and (iv) desolventizing, followed by deodorization and sealing in nitrogen atmosphere.

The report covers experience in an actual plant working on the above integrated scheme.

S.S.K.

GENERAL

Paper chromatography of phospholipides, by Rouser, G., *et al.*, *J. biol. Chem.*, 1956, **223** (1), 485.—A study of a variety of individual solvents and solvent mixtures showed that polar or ionic solvents were most suitable for the chromatography of phospholipides on non-impregnated filter paper. Mixtures of lutidine and acetic acid with alcohols or with chloroform were found to give satisfactory results.

Many useful lipide separations were accomplished, such as lecithin from sphingomyelin and cephalin; cephalin from sphingomyelin; lysolecithin from lecithin; acetal phospholipide or phosphatidic acid from all other phospholipides; and phospholipides (except phosphatidic acid) from fatty-acids, cholesterol, cholesterol palmitate, ceramide, and mono-, di-, and tri-glycerides. The separation of lecithin from either sphingomyelin or cephalin was accomplished only when small amounts of lipides were used. Larger amounts led to spot elongation and only partial separation.

Factors which influence the mobility of the phospholipides on paper were found to be solvent polarity, temperature, mode of application of the lipides to the paper, and lipide solubility, concentration, and structure.

These solvents were applied to P³²-labeled phospholipides of rat tissues. The presence of diacyl-phosphatidic acid could not be demonstrated, but several unidentified components were detected in these tissues and are believed to represent new phospholipides.

An explanation is presented of the chromatographic behaviour of the phospholipides on filter paper.

FOOD SCIENCE

BULLETIN OF THE CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE

MULTI-PURPOSE FOOD

Malnutrition is widely prevalent in our country and dietary surveys have shown that the masses are under-fed, their diets being deficient in quality and quantity. The need was therefore felt for a nutritious, low-cost food supplement which could be prepared from readily available raw materials, to help balance diets and relieve malnutrition. Hence a concentrated food was developed from specially prepared groundnut flour, Bengalgram flour and fortified with essential minerals and vitamins. Referred to as the Multi-Purpose Food or MPF, this food represents the culmination of a large volume of scientific work carried out as a special project at the Central Food Technological Research Institute, Mysore, with this end in view. Two ounces of MPF costing about eight *naye paise*, supply an adult consumer with a large part of the daily requirements of protein, vitamins and minerals. MPF does not require change in food habits. In fact, it can be incorporated in a large number of ordinary preparations for enhancing their nutritive value without affecting the taste. Feeding trials with the food, even for short periods, showed considerable improvement in the health of children.

A year ago, MPF was exhibited at the Rashtrapathi Bhavan when it received unique recognition from the Prime Minister, who contributed a lakh of rupees for making biscuits incorporating a similar composition, for distribution to children in flood and famine affected areas. The formula for making such fortified 'NUTRO' biscuits has been freely made available to the industry. These have thrice as much proteins as ordinary biscuits, a significant fact in view of the protein malnutrition prevalent in the country.

A number of important industrial canteens have already started using the MPF. The Southern Railways, the Buckingham and Carnatic

Mills Ltd., the Madras Electricity Supply System canteens and various other organizations have realised the value of supplying this nourishing food to workers in their canteens. Recently tests with the American version of the MPF showed that the efficiency of industrial workers in a particular area increased by 10 per cent due to the inclusion of MPF with the diet.

The work at the Institute has amply illustrated the unlimited possibilities of science in relieving malnutrition and raising nutritional levels. Applications of the findings in this regard have just begun. In this Special Number of the Bulletin an attempt has been made to collate all the scientific work that has gone into this project and present the available scientific evidence in regard to this protective food for the benefit of readers. At the same time emphasis has been laid on the applied aspects and the relevant details of manufacturing units have also been given.

For the past few years the Central Food Technological Research Institute has been manufacturing and distributing the MPF in spiced and unspiced forms to different parts of the country. Various private organizations and Government departments have offered their help, and in this connection special mention may be made of the U.S. Meals for Millions Foundation, the founder President of which, Mr. Clifford Clinton, was in India recently to discuss the large-scale production of this food. The support and help of the Council of Scientific and Industrial Research in this project has been a source of inspiration.

It is hoped that this Special Number will give complete information about the MPF project and help in bringing better appreciation of the scientific work that has gone into the development of MPF as well as its immense possibilities for our country.

STANDARDIZATION OF CONDITIONS FOR THE PRODUCTION OF INDIAN MULTI-PURPOSE FOOD

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Diet and nutritional surveys carried out in India, Africa and other Asian and South American countries have shown that the dietary of a large section of people suffers from multiple deficiencies *viz.*, proteins, vitamins and minerals¹⁻². As for proteins, a fair section, especially among the rice eating population, does not get sufficient quantity, though with other types of diets, *e.g.*, millet diets, the quality of proteins may also be an important factor. A deficiency syndrome named *Kwashiorkor*, which commonly occurs among malnourished infants and children particularly those belonging to low income groups has been shown to be mainly due to a deficiency of protein in the diet, even though some vitamin deficiencies may also be associated with it².

Protective foods like milk, eggs, fish, meat etc., are not available in sufficient quantities in the above mentioned countries. Consequently, it was felt that there was an urgent need to develop a highly nutritious, low cost protein food, fortified adequately with vitamins and minerals so that it could be used for making up the deficiencies in the diet. Further the product should be such

as could be manufactured in large quantities from readily available raw materials at low cost and which must be capable of being incorporated easily in the daily diet.

Although soyabean is not being grown at present in any appreciable quantity in India, yet fortunately enough, fairly large amounts of protein-rich foods of vegetable origin, especially the oil seed residues and pulses are available in India and the other countries mentioned above³. Many of these oil seed flours and pulses, though rich in protein are, however, deficient in certain vitamins and minerals; but, by suitable processing and blending of low fat oil seed flours and pulses, and fortifying them with essential vitamins and minerals, it should be possible to produce a supplementary food, which could be used to make up the deficiencies in the poor dietaries.

Very few studies have so far been reported on the preparation of processed protein foods fortified with vitamins and minerals. A process for the preparation of a highly nutritious protein food—known as the multipurpose food—was first developed in U.S.A. by Barsook⁴. The product consisted of expeller soya grits fortified with vitamins and minerals. Harris *et al*⁵ developed a highly nutritious soup powder by incorporating low fat groundnut flour with low fat soya flour, cooked pea flour, skim milk powder, with added flavours and condiments and fortified with essential amino acids and minerals. Subrahmanyam *et al*⁶ described a process for the preparation of a new type of balanced food in the form of broken vermicelli incorporating maize starch with groundnut flour, casein, dried yeast and fortifying with vitamins and minerals. Lal and De⁷ prepared a balanced food in the form of broken vermicelli from a blend of groundnut, soyabean, wheat and tapioca flours and dried yeast, with added common salt and condiments. During the past few years, investigations have been in progress in this Institute with the object of developing a process for the preparation of a highly nutritious multipurpose food, using the

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readily available raw material like groundnut meal as base. The present paper gives an account of studies on the standardisation of the conditions of the process.

Choice of raw materials

The protein concentrates available in India include the various edible oil seed meals and pulses. Out of the oil seed meals, only groundnut meal can be obtained in fairly large quantities. Sesame meal (*Sesamum indicum*) is available only in moderate amounts. Groundnut meal has about the same protein content as soyabean cake. Investigations reported earlier from this Institute have shown that specially processed low fat groundnut flour can be readily used for human consumption in admixture with tapioca flour and a small percentage of wheat flour in the form of composite grains, Mysore Flour, *chappathies* etc.⁸⁻¹⁰ The groundnut flour used in the above experiments had an attractive creamy colour and pleasant nutty flavour which was liked by consumers. Sesame meal is somewhat less rich in proteins than groundnut meal. From the nutritional point of view, however, sesame meal possesses the advantage that its protein is rich in the essential amino acid *viz.*, the methionine in which groundnut meal is deficient. Sesame meal, however, has a slightly bitter taste and hence could be used only in limited amounts in the diets. Bengalgram *dhal* is a pulse available at a low cost in large quantities and is already being consumed widely throughout India. The proteins of Bengalgram are particularly rich in the essential amino acid *viz.*, the lysine in which both groundnut and sesame meals are somewhat deficient¹². Data regarding the annual production of groundnut, sesame and Bengalgram is given in Table I.

TABLE I. Annual production of groundnut, Bengalgram and sesame seed

| Name of food | Production* for 1954-55 (1,000 tons) |
|------------------------------|---|
| Groundnut (in shell) ... | 3,823† |
| Bengalgram (whole pulse) ... | 5,125 |
| Sesame seeds ... | 592 |

* Figures taken from the All-India Final estimates issued by the Economic and Statistical Adviser in the Ministry of Food and Agriculture, Government of India.

† The approximate annual production of the cake will amount to about 1 million tons.

Processing of ingredients

Groundnut cake grits: Groundnut kernels of good quality were cleaned to remove foreign matter like pieces of stones and broken shells. The cleaned material was given a light roasting in an electric roaster and the cuticle (testa) was removed mechanically by rubbing the kernels and blowing off the detached cuticle (testa) in a current of air. The decuticled kernels were crushed in an expeller. The press cake so obtained had an oil content of about 8-10 per cent. It was coarsely ground in a disintegrator and the grits passing through 10 mesh sieve but retained on a 30 mesh sieve were separated. The groundnut cake grits were roasted lightly till a pleasant aroma developed.

Sesame cake grits: Sesame seed of the white variety was thoroughly cleaned of all foreign matter and was crushed in an expeller. The press cake thus obtained had a residual oil content of about 10 per cent. It was ground to a coarse powder in a flour mill.

Bengalgram grits: The Bengalgram *dhal* (split legume, free from husk) was obtained from the bazaar. It was cleaned of foreign matter, roasted in a revolving type electric roaster for 8-10 minutes at 120-130°C and coarsely ground into grits in the same way as groundnut cake.

Seasoning premix: Condiments like coriander seeds, black pepper, cinnamon bark, turmeric and asafoetida were mixed together in proper proportions, lightly roasted in the presence of a little hydrogenated fat and coarsely ground.

Analysis of ingredients

Data regarding the chemical composition of groundnut cake grits, Bengalgram grits, and sesame cake grits are given in Table II. Moisture,

TABLE II. The Chemical composition of Bengalgram *dhal* and low fat groundnut and sesame flours

| | Bengalgram <i>dhal</i> | Low fat groundnut flour | Low fat sesame flour |
|----------------------------------|---------------------------|-------------------------------|----------------------------|
| Moisture% ... | 10.8 | 10.1 | 10.3 |
| Protein (N × 6.25)% | 24.0 | 50.2 | 37.2 |
| Fat% ... | 4.5 | 9.2 | 12.5 |
| Crude fibre% ... | 0.4 | 0.6 | 4.2 |
| Carbohydrate (by diff.,) (g) | 57.5 | 25.4 | 28.6 |
| Ash% ... | 2.8 | 4.5 | 7.2 |
| Calcium% ... | 0.09 | 0.08 | 2.30 |
| Phosphorus% ... | 0.33 | 0.52 | 0.66 |
| Vitamin B ₁ (mg)% ... | 0.38 | 1.06 | 1.05 |
| Riboflavin (mg)% ... | 0.15 | 0.22 | 0.21 |
| Nicotinic acid (mg)% | 2.2 | 16.8 | 2.7 |

protein, ash, calcium and phosphorus were estimated according to the methods of A.O.A.C.¹³. Thiamine was determined according to the method of Swaminathan¹⁴. Riboflavin was estimated according to the method recommended by the American Association of Vitamin Chemists¹⁵.

Choice of MPF composition

In order to find out a suitable composition for Indian multi-purpose food which will be most acceptable to the people, four different compositions (vide Table III) were prepared using different proportions of the following ingredients: (i) low fat groundnut meal, (ii) low fat sesame meal, (iii) Bengalgram *dhal* and (iv) black gram *dhal*. Black gram *dhal* was incorporated in some compositions in consideration of the fact that its flavour is generally liked particularly in savoury dishes.

TABLE III. Composition of Indian multipurpose food

| Constituent | Formula 1 | Formula 2 | Formula 3 | Formula 4 |
|------------------------|-----------|-----------|-----------|-----------|
| Groundnut meal | 70 parts | 75 parts | 65 parts | 80 parts |
| Bengalgram <i>dhal</i> | 15 „ | 25 „ | 20 „ | nil |
| Blackgram <i>dhal</i> | 15 „ | nil | 5 „ | nil |
| Sesame meal ... | nil | nil | 10 „ | 20 parts |

Multipurpose food samples corresponding to the above compositions were prepared and their acceptability was compared by a panel of tasters both at the Central Food Technological Research Institute, Mysore, and the Indian Institute of Science, Bangalore. A summary of the results of these organoleptic studies is given in Table IV.

TABLE IV. Organoleptic evaluation of the different compositions of M.P.F.

| Product | Cooking quality | Organoleptic acceptability |
|---------------|-----------------|---|
| Formula 1 ... | Good | Acceptable |
| Formula 2 ... | Good | Highly acceptable |
| Formula 3 ... | Slightly pasty | Less acceptable than formulae 1 and 2. |
| Formula 4 ... | Slightly pasty | Slightly bitter and less acceptable than formulae 1, 2 and 3. |

On the basis of the above trials, therefore, formula 2 was finally selected for the large-scale preparation of Indian multipurpose food.

Fortification of the MPF

Since low fat groundnut flour and Bengalgram *dhal* are deficient in certain essential vitamins and minerals, the product was fortified with calcium phosphate, thiamine, riboflavin and vitamins A and D. The vitamins were added in the form of a premix after being mixed with a small quantity of groundnut flour.

Forms of the multipurpose food

Multipurpose food has been prepared in three different forms: (i) *Formula A*: seasoned (ii) *Formula B*: unseasoned and (iii) *Formula C*: unseasoned with 20 per cent skim milk powder.

The unseasoned product (Formula B) consists of a blend of groundnut cake grits (75 parts) and roasted Bengalgram grits (25 parts) and fortified with vitamins (thiamine, riboflavin and vitamins A and D) and calcium phosphate.

The seasoned (Formula A) product was prepared by the addition of seasonings and salt to the unseasoned product prepared as above.

The unseasoned multipurpose food containing skim milk powder (Formula C) was prepared by blending 80 parts of the finely powdered (60 mesh) unseasoned multipurpose food with 20 parts of skim milk powder.

Consumer acceptability trials with MPF

It was found that the seasoned multipurpose food could be incorporated at levels ranging from 25 per cent to 50 per cent in various popular savoury preparations based on cereals and pulses. The seasoned product, on being cooked as such yielded a tasty *dhal* substitute. The unseasoned product could also be readily incorporated at 25 to 50 per cent levels in various sweet preparations based on cereals and pulses. The unseasoned product containing skim milk powder was found to be suitable for the preparation of porridge, puddings and sweet dishes suitable for feeding weaned infants and convalescents. This formula has also been found to be very effective in the treatment of children and adults suffering from protein malnutrition¹⁶.

Chemical composition of MPF

The chemical composition of the unseasoned Indian multipurpose food, as compared with the American multipurpose food is given in Table V.

TABLE V. *The chemical composition of Indian and American multipurpose foods (values per 100 g.)*

| Constituent | Indian multi-purpose food | American multi-purpose food |
|---------------------------------|---------------------------|-----------------------------|
| Moisture (g) ... | 6.8 | 6.7 |
| Protein (N × 6.25) (g) ... | 41.9 | 42.3 |
| Fat (g) ... | 8.5 | 7.6 |
| Ash (g) ... | 7.0 | 6.5 |
| Carbohydrate (by diff.) (g) ... | 35.8 | 36.9 |
| Calcium (g) ... | 0.665 | 0.587 |
| Phosphorus (g) ... | 0.820 | 0.440 |
| Iron (mg) ... | 5.1 | 7.0 |
| Thiamine (mg) ... | 1.3 | 0.7 |
| Nicotinic acid (mg) ... | 14.0 | 7.0 |
| Riboflavin (mg) ... | 3.0 | 1.2 |
| Vitamin A (I.U.) ... | 3000 | 2940 |
| „ D (I.U.) ... | 300 | 235 |
| Calorific value ... | 387 | 386 |

It will be seen that the Indian product compares favourably with its American prototype in its content of the different essential nutrients.

Packaging and storage

The products were packed in air-tight tin containers. When packed in hermetically sealed cans without appreciable air space, the shelf lives of both the seasoned and unseasoned multipurpose food were satisfactory for a period of 9 months at 37°C and more than one year at room temperature (25-30°C). The keeping quality of the seasoned product was invariably better than that of the unseasoned product presumably due to the antioxidant properties of the spices¹⁷.

Marketing cost and distribution

It has been estimated that the marketing cost of the Indian multipurpose food (packed in 8 lb. or 28 lb. tin containers) will be approximately 12 annas per pound (1½ annas or 2 cents per serving of 2 ounces) including the container.

The product should preferably be distributed through the medical and health departments of Central and State Governments to hospitals, sanatoria, community project areas and Mater-

nity and Child Welfare Centres and for school lunch programmes.

A Meals for Millions Association of India has recently been formed with Dr Punjabrao Deshmukh, Union Minister of Agriculture as the President. Just like its American counterpart, this Association is a non-profit organization, dedicated to the relief and prevention of malnutrition in India. This organization can also help in the distribution and popularisation of the Indian multipurpose food.

Summary

1. An account of the investigations carried out at the Central Food Technological Research Institute, Mysore, on the development of the Indian version of multipurpose food is briefly described.

2. The availability and suitability of different indigenous raw materials for the preparation of Indian multipurpose food are discussed.

3. The processing of ingredients and the preparation of Indian multipurpose food in three forms *viz.*, (a) *seasoned*: for use in soups and savoury preparation, (b) *unseasoned*: for use in batters, puddings and sweet preparations and (c) unseasoned with 20 per cent skim milk powder for use in feeding weaned infants and convalescents and in the treatment of protein malnutrition, are described.

4. The Indian multipurpose food compared favourably with the American product in its content of various essential nutrients.

5. Both the *seasoned* and *unseasoned* products kept well in hermetically sealed containers for a period of one year at room temperature (25-30°C) and about 9 months at 37°C.

6. The marketing cost of the Indian multipurpose food has been estimated to be about twelve annas per lb. which is less than that of the American multipurpose food.

Acknowledgement

We are thankful to Drs K. V. Giri and R. Rajagopalan of the Indian Institute of Science, Bangalore, for helpful discussions and for kindly carrying out the consumer acceptability trials with the different samples of multipurpose food.

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NUTRITIVE VALUE OF INDIAN MULTIPURPOSE FOOD

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In a previous publication from this laboratory¹, a process for the large scale preparation of Indian multipurpose food has been described. The product consists of a blend of low fat groundnut flour and Bengalgram flour, fortified with calcium phosphate, vitamins A and D, thiamine and riboflavin and having a chemical composition similar to that of the American multipurpose food. The present paper relates to studies on the overall nutritive value of Indian multipurpose food as compared with the American multipurpose food.

Experimental

The Indian multipurpose food used in the present investigations was prepared according to the method of Subrahmanyam *et al*¹ by blending specially processed groundnut cake grits (75 parts) and Bengalgram grits (25 parts) and fortifying with calcium phosphate, thiamine, riboflavin and vitamins A and D in the required proportion. American multipurpose food, unseasoned (Formula B) used in the present study was kindly supplied by the Meals for Millions Foundation, Los Angeles, U.S.A. Their chemical compositions have already been reported¹.

Overall nutritive value of Indian MPF: The overall nutritive value of Indian multipurpose food as compared with the American multipurpose food was determined by the rat growth method².

Both the Indian and American multipurpose foods, constituted 40 per cent of the diet and were the sole sources of proteins, minerals, B-complex vitamins and vitamins A and D.

Two groups of freshly weaned young rats (12 rats in each group, weighing between 40 and 50 g. and distributed equally according to sex, litter, and body weight) were fed on the two experimental diets (Table I) containing the Indian

TABLE I. Composition of the experimental diets

| Constituent | | | | Diet I | Diet II |
|--------------------------|-----|---|-----|--------|---------|
| Indian multipurpose food | ... | | | 40.0 | ... |
| American | " | " | ... | ... | 40.0 |
| Corn starch | ... | | ... | 50.0 | 50.0 |
| Groundnut oil | ... | | ... | 9.0 | 9.0 |
| Sodium chloride | ... | | ... | 1.0 | 1.0 |

and American multipurpose foods respectively.

The rats were kept in individual cages with raised screen bottoms. Records of the daily intake and weekly increase in body weight were maintained. The feeding was continued for a period of 8 weeks. The average weekly increases in weights of rats fed on the two diets are given in Table II and the corresponding growth rates of rats are shown in Fig. I.

TABLE II. *Average weekly growth of rats fed on the experimental diets (duration of experiment: 8 weeks)*

| Diet | Average protein content of the diet (moisture free basis) (%) | Average initial body weight (g) | Average daily food intake (dry weight) (g) | Average weekly gain in body weight (g) |
|----------------------------|---|---------------------------------|--|--|
| Indian multipurpose food | 18.64 | 47.0 | 11.60 | 13.8 |
| American multipurpose food | 18.80 | 46.7 | 11.70 | 14.8 |

± 0.35
(10 d.f.)

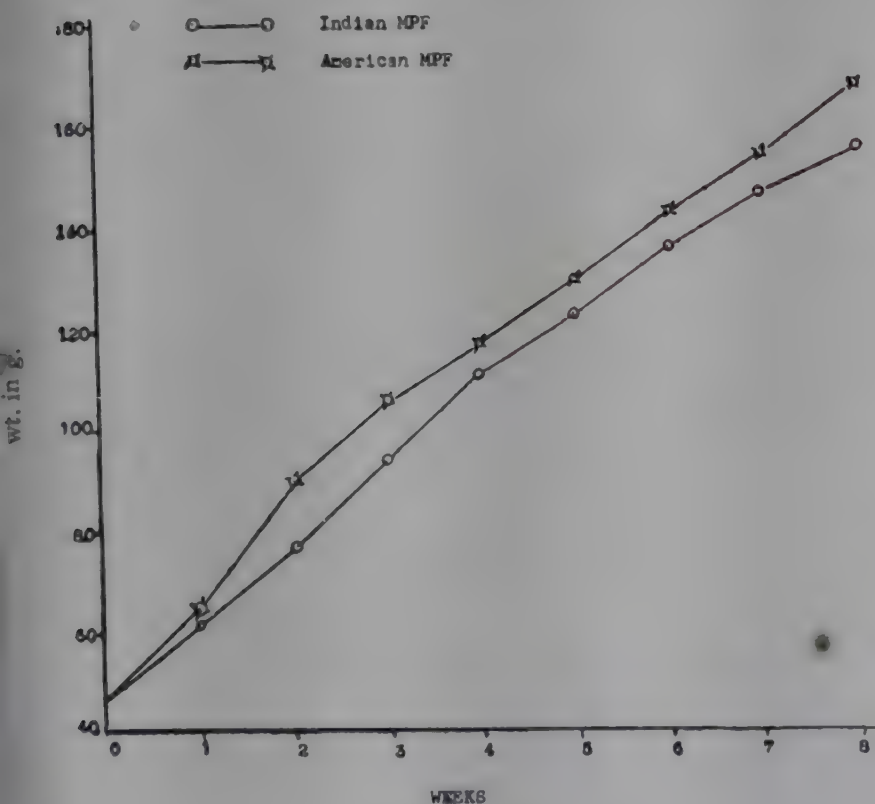


FIG. I

Comparative growth of rats fed Indian MPF and American MPF.

The results, on statistical analysis, did not reveal any significant difference between the growth promoting values of the Indian multi-

purpose food and the American multipurpose food.

Haemoglobin and red blood cell count in the blood of animals fed on similar diets containing Indian and American multipurpose foods respectively: After feeding for a period of 8 weeks, the haemoglobin and red blood cell count of all the experimental animals were determined in the blood drawn from the tail of the rats. Haemoglobin was estimated by the acid haematin method using a Sahli Hellige haemometer³ and red blood cell counts were made according to standard procedures using Neubauer's haemocytometer. The results are given in Table III.

TABLE III. *Haemoglobin and red blood cell count of experimental animals*

| Diet | Haemoglobin g./100 cc. | Red blood cells (Millions/c.mm) |
|--|------------------------|---------------------------------|
| (A) Indian Multipurpose food | 14.89 | 9.02 |
| (B) American Multipurpose food | 13.21 | 8.32 |
| Haemoglobin: A ~ B significant at 0.1% level | | |
| Red blood cell count: A ~ B not significant | | |

The results on statistical analysis showed that the haemoglobin content in the blood of the animals fed on Indian multipurpose food is significantly higher than that of the animals fed on the American multipurpose food. There was no significant difference in the red blood cell count of the experimental animals fed on the two diets.

Chemical composition of the liver and carcass of rats fed on diets containing Indian and American multipurpose foods: After the determination of the haemoglobin and red blood cell count, the animals were anaesthetized with sodium amytal. The rats were bled through the abdominal aorta to ensure a minimum and relatively uniform amount of residual blood in the livers. The whole liver was then quickly excised, washed with normal saline to remove any adhering blood, wiped between filter papers and immediately weighed in glass dishes. The moisture content in the liver was determined by drying to a constant weight at 90-95°C in a hot air oven. The dry liver samples were powdered

and aliquots taken for the analysis of total nitrogen and fat. Total nitrogen was determined by the microkjeldahl method. For the determination of fat, a weighed amount of the dried and powdered liver was extracted in a Soxhlet apparatus first by a mixture of absolute alcohol and ethyl ether and then by ethyl ether according to the method of Tyner *et al*⁴.

The analysis of the carcass of the animals was carried out as follows: the contents of the gastrointestinal tract were removed by squeezing and the whole carcass was mashed in a meat mincer and then weighed. The moisture content of the body was determined by drying in a hot air oven at a temperature of 90-95° C. The addition of about 200 ml. of absolute alcohol helps in the quick drying of the material. The dry carcass was then powdered and aliquots were taken for the estimation of total nitrogen and fat. The procedures adopted for the estimation of total nitrogen and fat in the body were the same as those followed for the analysis of the liver. The results are given in Tables IV and V.

The results on statistical analysis did not reveal any significant difference in the moisture, protein and fat content of the livers of rats fed on Indian and American multipurpose foods respectively.

The results on statistical analysis showed no significant difference in the moisture, protein

and fat content of the bodies of the experimental rats.

Studies on the value of Indian multipurpose food for supporting reproduction and lactation in rats: The results obtained in the above experiments showed that the Indian multipurpose food when incorporated at 40 per cent level in a diet supplemented with starch and fat, supported good growth in albino rats, comparable to that observed on the stock diet in the same colony. It was therefore considered of interest to study whether the same diets would be adequate for supporting reproduction and lactation in rats.

Sixteen weanling rats, eight males and eight females weighing about 40-50 g. were fed on the diet based on Indian multipurpose food (Table I) for a period of 12 weeks. The average weekly increase in weight of the rats during the 12 weeks feeding was 12.40 g. After feeding for a period of 12 weeks, the rats were mated. The animals were fed throughout on the same experimental diet. No extra milk or other supplement was given to the rats during the gestation or lactation period. Data on the reproduction and lactation capacity of the rats are given in Table VI.

The average increase in body weight of the first generation of rats on the experimental diet during a period of 8 weeks after weaning was 12.3 g. as compared with 14.5 g. of the parents under similar conditions.

TABLE IV. Chemical composition of the liver of rats fed on experimental diets

| Diet | Average body wt. (g) | Average wt. of liver (g) | Composition of fresh liver | | |
|--------------------------------|----------------------|--------------------------|----------------------------|--------------------------|-------------------------|
| | | | Moisture % | Protein% (N × 6.25) | Fat % |
| Indian multipurpose food ... | 173.6 | 6.03 | 72.95 | 18.95 | 2.69 |
| American multipurpose food ... | 185.5 | 6.07 | 74.27 | 17.20 | 2.73 |
| | | | ± 0.715 (10 d.f.) | ± 0.72 ± 0.78 | ± 0.08 (10 d.f.) |

TABLE V. Composition of the body of the rats fed on experimental diets

| Diet | Average body wt. (g) | Composition of the body | | |
|--------------------------------|----------------------|-------------------------|-----------------------|------------------------|
| | | Moisture % | Protein % | Fat % |
| Indian multipurpose food ... | 173.6 | 57.05 | 19.33 | 17.75 |
| American multipurpose food ... | 185.5 | 54.41 | 21.05 | 19.35 |
| | | ± 1.76 (5 d.f.) | ± 1.6 (5 d.f.) | ± 0.71 (5 d.f.) |

TABLE VI. *Reproduction and lactation capacity of experimental rats*

| No. of females mated | No. of animals pregnant | No. of litters born | No. of litters weaned | Average weight of litters (g) | | | | | |
|-------------------------|----------------------------|------------------------|--------------------------|-------------------------------|-------|------|------|------|-------|
| | | | | Days | Weeks | | | | |
| | | | | | 0 | 1 | 2 | 3 | 4 |
| 4 | 4 | 26 | 26 | 3.6 | 9.0 | 20.6 | 26.0 | 40.6 | 139.0 |

The above results show that the multipurpose food when fed at a level of 40 per cent in the diet along with starch and fat, promoted good growth, reproduction and lactation in rats. The growth rate of the first generation of rats in a period of 8 weeks after weaning was, however, slightly less than that of the parents.

Discussion

The results obtained in the present investigation show that there is no significant difference in the overall nutritive value of Indian and American multipurpose foods as judged by the growth of young rats. Rats fed on diets in which the Indian or American multipurpose food was the only source of protein, B-complex vitamins, minerals and vitamins A and D, grew equally well, the average weekly increase in weight during a period of eight weeks being 13.8 g. and 14.8 g. respectively. Analysis of the livers and carcass of the experimental animals fed diets containing Indian or American multipurpose food, for moisture, protein and fat showed no significant difference between the two groups of rats. The rats fed on a diet containing Indian multipurpose food had a slightly higher content of haemoglobin than those fed on a diet containing American multipurpose food. Studies on the value of Indian multipurpose food for supporting the reproduction and lactation of rats showed that the food when incorporated at 40 per cent level in a diet supplemented with starch and fat promoted reproduction and lactation in rats. The growth rate of the first generation of rats during a period of 8 weeks after weaning was, however,

less than that observed in the same period for the parents. This might have been due to the deficiency of the multipurpose food in vitamin B₁₂⁵.

Summary

1. No significant difference was observed in the overall growth promoting value of Indian and American multipurpose foods, when they were incorporated at 40 per cent level in diets containing starch and fat, and when they constituted the only source of proteins, minerals, B-complex vitamins and vitamins A and D.

2. Haemoglobin and red blood cell contents were estimated in the blood of experimental rats fed for a period of 8 weeks on the experimental diets. Rats fed on a diet containing Indian multipurpose food had a slightly higher content of haemoglobin than the rats fed on a similar diet containing American multipurpose food. No significant difference in the red blood cell content in the blood of the two groups of rats was noted.

3. The liver and body of the rats fed diets containing Indian and American multipurpose foods were analysed for moisture, protein and fat. No significant difference was observed in the composition of the liver and body of the experimental rats fed on diets containing Indian or American Multipurpose food respectively.

4. Studies carried out to find out the value of Indian multipurpose food for supporting reproduction and lactation of rats, showed that diet containing the Indian multipurpose food at 40 per cent level along with starch and fat can support reproduction and lactation in albino rats.

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SUPPLEMENTARY VALUE OF INDIAN MULTIPURPOSE FOOD TO POOR VEGETARIAN DIETS BASED ON DIFFERENT CEREALS AND MILLETS

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It is now generally recognized that the diets consumed by a vast majority of the people belonging to the low income groups in India, consist predominantly of cereals and millets and only small quantities of pulses, vegetables and fats and negligible amounts of milk and other animal foods¹. The diets in general have been found to be deficient in vitamin A, riboflavin, calcium and proteins of high biological value². The nutritive value of poor vegetarian diets based on the different cereals and millets has been studied by different workers by growth experiments on rats²⁻⁴. The results indicate that the growth-promoting value of diets based on *ragi*, wheat and *jowar* is higher than that of rice diet; the average weekly increase in body weight of rats (in a period of 8 weeks) ranging from 6-9 g. when fed on *ragi*, wheat and *jowar* diets and 4-6 g. on rice diet as compared with 14-15 g. on a well balanced stock diet. The lower growth-promoting value of poor Indian diets is due to their deficiency in various dietary essentials. Aykroyd and Krishnan² investigated the supplementary value of various foods like milk powder, whole egg and pulses to poor rice diet. Their results showed that both whole and skim milk powder were highly effective, egg moderately effective and pulses least effective in improving the growth promoting value of the poor rice diet. With a view to providing a low cost food supplement which could be used for making up the deficiencies in the poor Indian diets, a process for the preparation of a multipurpose food was developed by Subrahmanyam *et al*⁵. Earlier studies from this laboratory have shown that the multipurpose food when incorporated at 40 per cent level in a diet supplemented with starch and fat possessed a high nutritive value as judged by its capacity for promoting growth, reproduction and lactation in rats⁶. The present paper relates to studies on the supplementary value of Indian multipurpose food at 12.5 per cent level to poor vegetarian diets based on rice, *ragi*, wheat and *jowar*.

Experimental

The supplementary value of different compositions of Indian multipurpose food at 12.5 per cent level of intake to poor rice diet: The four compositions of multipurpose food used in the present experiments were the same as those described in an earlier publication⁵. The relative supplementary value of the four compositions at 12.5 per cent level to poor rice diet was studied by the rat growth method⁴. The composition of the poor rice diet used in this investigation was the same as that recommended by the Vanaspati Research Advisory Committee⁷.

Five groups of freshly weaned rats (about 4 weeks old and 6 in each group distributed equally according to sex, weight and litter mates) were fed on a poor rice diet and the same diet in which 12.5 per cent of rice was replaced by one of the four compositions of multipurpose food. The methods adopted for the preparation of the diets and the feeding of the experimental animals were the same as those described by Subrahmanyam *et al*⁴. The duration of the experimental period was 8 weeks. Data regarding the average food intake and the weekly increase in body weight of animals are given in Table I.

The results on statistical analysis revealed that (1) the four compositions of multipurpose food when incorporated at 12.5 per cent level in the diet produced a marked improvement in the growth promoting value of the rice diet and (2) there was no significant difference among the four compositions with respect to their supplementary value to poor rice diet.

Supplementary value of multipurpose food (Formula 2) to poor vegetarian diets based on wheat, ragi, jowar and rice: The results obtained in the above experiments showed that there was no significant difference in the supplementary value of the four compositions of multipurpose food to poor rice diet. As organoleptic evaluation revealed that formula 2 based on 75 parts of groundnut flour and 25 parts of Bengalgram

TABLE I. *Supplementary value of different formulae of multipurpose food (at 12.5% level) to poor rice diet*

| Diet composition | Average weekly increase in weight (g) |
|--|---------------------------------------|
| Poor rice diet | 5.03 |
| Poor rice diet + 12.5% multipurpose food (formula 1)* | 12.50 |
| Poor rice diet + 12.5% multipurpose food (formula 2)* (†) | 12.60 |
| Poor rice diet + 12.5% multipurpose food (formula 3)* | 12.60 |
| Poor rice diet + 12.5% multipurpose food (formula 4)* | 12.70 |

* Formula 1: Groundnut meal, 70 parts; Black gram *dhal*, 15 parts; Bengalgram *dhal*, 15 parts.

* Formula 2: Groundnut meal, 75 parts; Bengalgram *dhal* 25 parts.

* Formula 3: Groundnut meal 65 parts; Bengalgram *dhal*, 20 parts, black gram *dhal*, 5 parts and sesame meal, 10 parts.

* Formula 4: Groundnut meal, 80 parts; Sesame meal, 20 parts.

(†) Indian multipurpose food.

dhal was the most acceptable⁵, further experiments were, therefore, carried out only with this formula which will be referred to as Indian multipurpose food in this paper.

The supplementary value of the Indian multipurpose food as compared with American multipurpose food at 12.5 per cent level to poor vegetarian diets based on wheat, *ragi*, *jowar* and rice were studied by the rat growth method. The composition of the poor vegetarian diets was the same as that described by Subrahmanyam *et al*⁴. Groups of freshly weaned albino rats (8 in each group and distributed equally according to sex, litter mates and body weight) were fed *ad lib* on poor vegetarian diets based on rice, wheat, *jowar* and *ragi* and the same diets in which 12.5 per cent of the cereal or millet was replaced by the Indian multipurpose food or American multipurpose food. The methods adopted for the preparation of the experimental diets and the feeding of experimental animals were the same as those described by Subrahmanyam *et al*⁴. The data regarding the average weekly increase in body weight and the daily food intake of the animals are given in Table II.

Results

The results on statistical analysis showed that (1) both Indian and American multipurpose foods when incorporated at 12.5 per cent level,

TABLE II. *Supplementary value of Indian and American multipurpose foods to poor vegetarian diets*
(Duration of experiment, 8 weeks)

| Expt. No. | Diet | Average daily food intake (dry basis) (g). | Average weekly increase in weight (g). |
|-----------|--|--|--|
| 1. | Poor rice diet | 7.4 | 5.03 |
| | Poor rice diet + 12.5% Indian MPF | 9.97 | 14.59 |
| | Poor rice diet + 12.5% American MPF | 9.90 | 16.12 |
| 2. | Poor wheat diet | 7.80 | 7.81 |
| | Poor wheat diet + 12.5% Indian MPF | 9.80 | 12.47 |
| | Poor wheat diet + 12.5% American MPF | 9.82 | 13.59 |
| 3. | Poor <i>jowar</i> diet | 8.2 | 8.42 |
| | Poor <i>jowar</i> diet + 12.5% Indian MPF | 10.1 | 14.0 |
| | Poor <i>jowar</i> diet + 12.5% American MPF | 10.2 | 14.4 |
| 4. | Poor <i>ragi</i> diet | 8.1 | 8.45 |
| | Poor <i>ragi</i> diet + 12.5% Indian MPF | 10.1 | 13.32 |
| | Poor <i>ragi</i> diet + 12.5% American MPF | 10.1 | 14.45 |

had a marked supplementary value to the poor vegetarian diets based on rice, wheat, *jowar* and *ragi* and (2) there was no significant difference between the Indian and American multipurpose foods with respect to their supplementary value to the different diets.

Summary

1. The supplementary value of four compositions of multipurpose food (containing different proportions of low fat groundnut meal, low fat sesame meal, Bengalgram *dhal* and black gram *dhal*) at 12.5 per cent level to poor rice diet was determined by the rat growth method. All the four compositions were found to produce a marked improvement in the growth-promoting value of the diet. No significant difference was, however, observed among the four compositions with respect to their supplementary value to poor rice diet.

2. The Indian multipurpose food (consisting of a blend of 75 parts of low fat groundnut flour and 25 parts of roasted Bengalgram flour

and fortified with calcium and essential vitamins) when incorporated at 12.5 per cent level in poor Indian diets based on rice, wheat, *ragi* and *jowar* was found to produce a marked increase in the growth-promoting value of the diets, comparing well in this respect with the American multipurpose food.

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THE NUTRITIVE VALUE OF THE PROTEINS OF INDIAN MULTIPURPOSE FOOD

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In earlier publications^{1,2} from this laboratory, the results of investigations on the overall nutritive value of Indian multipurpose food and its supplementary value to poor Indian diets based on different cereals and millets have been reported. The main sources of protein in the Indian multipurpose food are low fat groundnut flour and Bengalgram *dhal*. The available evidence would show that the proteins of groundnut and Bengalgram possess a fairly high biological value^{3,4}. Vijayaraghavan and Sreenivasan⁵ reported that Bengalgram proteins are rich in certain essential amino acids especially lysine and threonine, but deficient primarily in tryptophane and to a lesser extent in methionine. The limiting amino acids in groundnut proteins are methionine, and threonine⁶. The proteins of Bengalgram and groundnut may have a mutual supplementary value. In view of the fact that methionine is a limiting amino acid in the proteins of both Bengalgram and groundnut, the possibility of making up the methionine deficiency by the incorporation of a protein food like sesame cake which is rich in methionine, was also investigated. Further, the above materials have been subjected to a certain degree of heat treatment during the preparation of multipurpose food involving light roasting for about 15-20 minutes. This heat treatment may affect to a certain extent the biological value of the proteins⁷. In the case of the proteins of groundnut and Bengalgram, it

has been reported that moderate heat treatment improves the biological value of the proteins^{8,9}. Moreover, both groundnut and Bengalgram proteins have been reported to supplement to a significant extent the cereal proteins^{4,9}. In the present paper, the biological values of the proteins of four compositions of multipurpose food as compared with the American multipurpose food and also of the rice diet supplemented at 12.5 per cent level with the Indian and American multipurpose foods, have been determined.

Experimental

The four different compositions of Indian multipurpose food and the sample of American multipurpose food used in the present study were the same as those described in the earlier investigations^{1,2}. The biological value of the proteins was determined by two methods (1) Nitrogen balance method of Mitchell¹⁰ and (2) Rat growth method of Osborne, Mendel and Ferry¹¹ as described by Swaminathan¹².

Nitrogen balance method: The biological value and digestibility coefficient of the proteins were determined at 10 per cent level of protein intake, using young albino rats. Five groups of six growing male rats, weighing between 60-70 g. were used for the experiment. The composition of the experimental diets is given in Table I.

The techniques of feeding the animals, collection and preservation of urine were similar to

TABLE I. *Percentage composition of experimental diets*

| Constituent | Diet I | Diet II | Diet III | Diet IV | Diet V |
|-----------------------------|--------|---------|----------|---------|--------|
| Multipurpose food (i) ... | 23.3 | ... | ... | ... | ... |
| Multipurpose food (iii) ... | ... | 23.2 | ... | ... | ... |
| Multipurpose food (iv) ... | ... | ... | 20.7 | ... | ... |
| Indian multipurpose food | ... | ... | ... | 22.2 | ... |
| American multipurpose food | ... | ... | ... | ... | 19.3 |
| Vitaminised starch ... | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Powdered sugar ... | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Groundnut oil ... | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Shark liver oil* ... | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Salt mixture † ... | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Corn starch ... | 47.7 | 47.8 | 50.3 | 48.8 | 51.7 |

* Shark liver oil supplied the daily requirements of vitamins A and D.

† Osborne Mendel salt mixture.

those described by Swaminathan¹³. The animals were first fed a low protein diet (4 per cent egg protein) and the endogenous excretion of nitrogen in urine and faeces were determined during a five day collection period after a six day preliminary period. The animals were then kept on the experimental diets containing the different compositions of multipurpose food and the urine and faeces collected for five days after a six day preliminary period. Records of the food intake by different animals were maintained. The nitrogen content of the diet, urine and faeces were determined by the Kjeldahl method. The biological value and digestibility coefficient of the different proteins, calculated from the metabolism data, are given in Table II.

TABLE II. *Digestibility coefficient and biological value of the proteins of different compositions of multipurpose food and American multipurpose food*
(By nitrogen balance method)

| Diet | Average digestibility coefficient | Average biological value |
|--------------------------------|-----------------------------------|--------------------------|
| Multipurpose food (i) ... | 95.29 | 57.34 |
| Multipurpose food (iii) ... | 95.80 | 60.62 |
| Multipurpose food (iv) ... | 96.26 | 60.43 |
| Indian multipurpose food | 95.68 | 59.53 |
| American multipurpose food ... | 95.03 | 58.89 |
| | ± 0.97 (20 d.f.) | ± 1.17 (20 d.f.) |

Multipurpose food (i): Groundnut meal, 70 parts; black gram *dhal*, 15 parts; Bengalgram *dhal* 15 parts.

Multipurpose food (iii): Groundnut meal, 65 parts; Bengalgram *dhal*, 20 parts, black gram *dhal* 5 parts and sesame meal, 10 parts.

Multipurpose food (iv): Groundnut meal, 80 parts; sesame meal, 20 parts.

Indian multipurpose food or multipurpose food (ii): Groundnut meal, 75 parts and Bengalgram *dhal* 25 parts.

Rat growth method: The protein efficiency ratio of the proteins of the different compositions was determined at 10 per cent level of protein intake. The compositions of the experimental diets were the same as given in Table I. Five groups of young albino rats about four weeks old and weighing between 40-50 g (3 males and 3 females in each group) were used in the experiment. Each group was fed *ad lib* on one of the experimental diets for a period of 8 weeks. The animals were weighed weekly. Careful records of the food intake of each animal were maintained. Data regarding the protein efficiency ratio of the proteins of the five different samples are given in Table III.

TABLE III. *Protein efficiency ratio of the proteins of different samples of multipurpose food at 10% level of protein intake (experimental period—8 weeks)*

| Name of multipurpose food* | Protein efficiency ratio |
|--|--------------------------|
| Multipurpose food (i) ... | 1.38 ± 0.050 |
| Multipurpose food* (iii) ... | 1.64 ± 0.052 |
| Multipurpose food* (iv) ... | 1.59 ± 0.050 |
| Indian multipurpose food* (multipurpose food formula II) ... | 1.40 ± 0.050 |
| American multipurpose food* ... | 1.67 ± 0.050 |

* The compositions of the different foods is given under Table II.

It will be seen from the results given in Table III that the protein efficiency ratios of the proteins of the multipurpose food (compositions *iii* and *iv*) containing sesame cake and the American multipurpose food are slightly higher than those of the proteins of the multipurpose food (Composition (i)) and the Indian multipurpose food (Multipurpose food formula II).

Protein efficiency ratio of mixed proteins of poor rice diet supplemented with Indian and American multipurpose foods: The protein efficiency ratio of mixed proteins of poor rice diet supplemented with Indian and American multipurpose foods, at 12.5 per cent level, was determined by the

rat growth method as described in the above experiment. The composition of the diets used in this study is given in Table IV.

TABLE IV. *Composition of experimental diets*

| Constituents | Diet I | Diet II |
|---|--------|---------|
| Indian multipurpose food ... | 12.5 | ... |
| American multipurpose food ... | ... | 12.5 |
| Rice flour ... | 66.0 | 66.0 |
| Tur dhal (<i>Cajanus indicus</i>) ... | 5.0 | 5.0 |
| Salt mixture ... | 3.0 | 3.0 |
| Vitaminised starch ... | 0.33 | 0.33 |
| Vegetables (dehydrated)*... | 1.60 | 1.60 |
| Shark liver oil ... | 1.0 | 1.0 |
| Skim milk powder ... | 0.9 | 0.9 |
| Common salt ... | 0.3 | 0.3 |
| Groundnut oil ... | 5.0 | 5.0 |

* Dehydrated brinjal (1.3 g.) and amaranthus leaves (0.3 g.) were incorporated in the diet.

The methods adopted for the preparation of the diets and the feeding of animals were the same as those followed in the above experiment. The results are given in Table V.

TABLE V. *Protein efficiency ratios of the mixed proteins of poor rice diet supplemented with Indian and American multipurpose foods (protein level 14 %, experimental period, 8 weeks)*

| Group No. | Diet | Protein content of the diet on moisture free basis | Protein efficiency ratio |
|-----------|---|--|--------------------------|
| 1 | Poor rice diet supplemented with Indian multipurpose food at 12.5 % level ... | 13.83 | 1.67 |
| 2 | Poor rice diet supplemented with American multipurpose food at 12.5 % level ... | 14.21 | 1.69 |

± 0.22
(8. d.f.)

Statistical analysis of the results showed that there was no significant difference between the protein efficiency ratios of the proteins in the two diets. The results indicate that the proteins of the Indian multipurpose food supplemented those of the poor rice diet to the same extent as the proteins of the American multipurpose food.

Discussion

The results presented in Table II show that there is no significant difference between the

biological value and digestibility co-efficient of proteins of the different compositions of multipurpose food and the American multipurpose food, as determined by the nitrogen balance method. The results reported in Table III show that the proteins of Indian multipurpose food, based on a mixture of 75 parts of groundnut meal and 25 parts of Bengalgarm *dhal*, have a fairly high protein efficiency ratio of 1.4 (at 10 per cent level of protein intake) which is only slightly less than that of the proteins of the American multipurpose food containing soya grits. Addition of 10 to 20 per cent of sesame cake to groundnut flour and Bengalgram *dhal* mixture increased the protein efficiency of the proteins of the mixture to the same level as that of American multipurpose food. This increase in the protein efficiency ratio of the mixture may be due to the methionine supplied by the sesame meal to the groundnut flour, as the latter is deficient in methionine. Addition of small amounts of black gram *dhal* did not cause any increase in the protein efficiency ratio of groundnut flour—Bengalgram *dhal* mixture.

The results given in Table V show that the protein efficiency ratios of the mixed proteins of poor rice diet supplemented at 12.5 per cent level with Indian or American multipurpose food are quite high (1.67) and nearly the same. The results indicate that the proteins of Indian multipurpose food supplemented the proteins of the poor rice diet to the same extent as those of the American multipurpose food. This is evidently due to the fact that the cereal and millet proteins which are good sources of methionine and threonine¹⁸, make up the deficiencies of the two amino acids in the groundnut proteins.

Summary

1. The biological value of the proteins of four compositions of multipurpose food (containing different proportions of low fat groundnut meal, low fat sesame meal, Bengalgram *dhal* and black gram *dhal*) and American multipurpose food, was determined by the nitrogen balance and rat growth methods.

2. No significant difference was observed in the biological value and digestibility coefficient of the proteins of the different compositions of Indian multipurpose food and the American

multipurpose food as determined by the nitrogen balance method.

3. The protein efficiency ratios (at 10% level) of the proteins of the Indian and American multipurpose foods were found to be 1.4 and 1.67 respectively. Addition of sesame cake at 10 and 20 per cent levels to the Indian multipurpose food was found to increase the protein efficiency ratio of the mixed proteins to 1.59 and 1.64 respectively.

4. The protein efficiency ratios at 14 per cent level of the mixed proteins of the rice diet supplemented with Indian and American multipurpose foods were found to be 1.67 and 1.69 respectively, indicating thereby that the proteins of Indian multipurpose food supplemented those of the rice diet to the same extent as the proteins of American multipurpose food.

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EFFECT OF SUPPLEMENTARY MULTIPURPOSE FOOD ON THE GROWTH AND NUTRITIONAL STATUS OF SCHOOL CHILDREN

During recent years considerable interest has been shown in different countries in evolving suitable supplementary foods from indigenous resources for improving the nutrition of the vulnerable groups of the population—especially pre-school children and children of school going age^{1,2}. Aykroyd *et al*³ reported that supplementation of the diet of school children with skim milk powder improved significantly their nutritional status. Subrahmanyam *et al*⁴ studied the supplementary value of vegetable milk curds to the diet of school children and observed that supplementation of their diet with 12 oz. of vegetable milk curds daily, significantly improved their growth and nutritional status. Recently a process for the preparation of a highly nutritious food was developed by Subrahmanyam *et al*⁵. Investigations on experimental animals have shown that the food forms a good supplement to poor Indian diets⁶⁻⁸. The present note gives an account of an experiment carried out for finding out the effect of supplementing the diet with 2 oz. of Indian multipurpose food daily on the growth and nutritional status of school children subsisting on an ill-balanced diet.

The Indian multipurpose food used in the

present investigations was prepared according to the method described by Subrahmanyam *et al*⁵. Forty six girls aged between 4-12 years and free from any disease likely to interfere with the experiment, were selected for the study. Initial heights, weights, red blood cell count, haemoglobin level and nutritional status of the children were determined by the methods described by Subrahmanyam *et al*⁴. On the basis of initial heights and weights, the children were paired and the members of each pair allotted at random to two groups. The children in the control group received the usual orphanage diet while the children in the experimental group received a similar diet, supplemented daily with 2 oz., of Indian multipurpose food, given either in the form of soup or chutney. Two ounces of the supplement provided the following quantities of different nutrients; protein 20.6 g.; calcium 280 mg.; phosphorus 370 mg.; thiamine 0.8 mg.; riboflavin 1.7 mg.; nicotinic acid 7.9 mg.; Vitamin A 1704 I.U.; and Vitamin D 170 I.U. In order to equalise the calorie intake in the two groups, each child in the control group was given daily one ounce of corn starch and one ounce of sugar in the form of pudding.

The feeding was continued for a period of five months, at the end of which measurements of height, weight, R.B.C. count and haemoglobin were made. The children were also assessed for their nutritional status. All the children relished the supplement and none complained of any digestive trouble during the experimental period.

The data obtained were statistically analysed and the results are given in Tables I and II. It will be seen from Table I that the average increase in height, weight, red blood cell count and haemoglobin level in the experimental group was larger than that observed in the control group, the difference being highly significant. Eighteen children in the experimental group improved in their nutritional status, while none in the control group showed improvement. On the other

hand, thirteen children in the control group showed deterioration, while none in the experimental group showed any deterioration. It is also of interest to note that the improvement in the growth and nutritional status of children observed in the present study with a supplement of 2 ounces of multipurpose food is almost equal to that reported earlier with a supplement of 12 ounces of groundnut curds⁴.

Our thanks are due to the authorities of the Good Shepherds Convent, Mysore for providing facilities for conducting the experiment.

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TABLE I. *Institution Feeding Experiments with Indian multipurpose food. Average values of the initial and final measurements of the children in the control and experimental groups (23 Children per group)*

| Character | Control Group | | | Experimental group | | | Difference in the increases (Experimental minus control) | Significance of the difference |
|---|---------------|-------|----------|--------------------|-------|----------|--|--------------------------------|
| | Initial | Final | Increase | Initial | Final | Increase | | |
| Height (inches) ... | 45.83 | 46.35 | 0.52 | 45.66 | 46.62 | 0.96 | + 0.44 ± 0.09 (22 d f.) | Significant at 0.1% |
| Weight (pounds) ... | 41.56 | 42.56 | 1.00 | 41.79 | 44.40 | 2.61 | + 1.61 ± 0.40 (22 d.f.) | „ at 0.1% |
| Haemoglobin (g/100cc) ... | 10.62 | 10.75 | 0.13 | 10.77 | 11.77 | 1.00 | + 0.87 ± 0.21 (22 d.f.) | „ at 0.1% |
| Red Blood Cell (10 ⁶ /Cu. mm.) ... | 4.30 | 4.37 | 0.07 | 4.22 | 4.55 | 0.33 | + 0.26 ± 0.11 (22 d.f.) | „ at 2.0% |

TABLE II. *Nutritional Status of Children*

| Nutritional Deficiency score* | Initial nutritional status of children | | Changes in the nutritional status of control and experimental groups | | | | | |
|-------------------------------|--|--------------------------------|--|------------|--------------|--------------------------------|------------|--------------|
| | Control (No. of children) | Experimental (No. of children) | Control (No. of children) | | | Experimental (No. of children) | | |
| | | | Improved | Stationary | Deteriorated | Improved | Stationary | Deteriorated |
| 0 | 0 | 1 | ... | ... | ... | ... | 1 | ... |
| 1 | 1 | 4 | ... | ... | 1 | 1 | 3 | ... |
| 2 | 1 | 2 | ... | 1 | ... | 2 | ... | ... |
| 3 | 4 | 8 | ... | 1 | 3 | 7 | 1 | ... |
| 4 | 5 | 5 | ... | 2 | 3 | 5 | ... | ... |
| 5 | 5 | 2 | ... | 1 | 4 | 2 | ... | ... |
| 6 | 4 | 1 | ... | 2 | 2 | 1 | ... | ... |
| 7 | 3 | 0 | ... | 3 | ... | ... | ... | ... |
| Total | 23 | 23 | ... | 10 | 13 | 18 | 5 | ... |

* According to the recommendation of the Indian Council of Medical Research; Nutrition Advisory Committee (1948).

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THE EFFECT OF SUPPLEMENTARY MULTIPURPOSE FOOD ON THE METABOLISM OF NITROGEN, CALCIUM AND PHOSPHORUS IN UNDERNOURISHED CHILDREN

In a previous publication from this laboratory, it was reported that undernourished children subsisting on an inadequate and ill-balanced vegetarian diet grew at a subnormal rate and showed a remarkable adaptation to low levels of intake. They maintained on the average, slightly positive nitrogen, calcium and phosphorus balances¹. In the preceding paper Subrahmanyam *et al*² reported that supplementation of the diet of similar undernourished children with 2 oz. of Indian multipurpose food daily for a period of six months produced a marked improvement in their growth and nutritional status. It was, therefore, considered of interest to study the effect of the multipurpose food supplement on the metabolism of nitrogen, calcium and phosphorus. The present note gives an account of the results obtained in this study.

The present investigation was carried out when the institution feeding experiment with Indian multipurpose food² had been in progress for 3 months. Five pairs of children aged 8-12 years were selected from the control and experimental groups. The girls in each pair were comparable in age, weight, height and nutritional status. Both the groups received the usual orphanage diet which on a daily average basis had the following composition: rice 133.4 g; ragi 16.9 g; Bengalgram *dhal* 7.6 g; horse gram 7.3 g; bread 34.0 g; butter oil 4.3 g; radish 10.6 g; pumpkin 12.2 g; brinjal 19.1 g; tomato 4.4 g; skim milk powder 8.6 g; jaggery 19.0 g; salt 9.2 g; spices and condiments 6.2 g. The ex-

perimental group received daily in addition to the above diet 2 oz. of multipurpose food in the form of soup or chutney. Two ounces of this supplement provided the following nutrients; protein 20.6 g; calcium 280 mg; phosphorus 370 mg; thiamine 0.8 mg; riboflavin 1.7 mg; nicotinic acid 7.9 mg; vitamin A 1704 I.U., vitamin D 170 I.U. and calories 210. In order to equalise the calorie intake in the two groups, each child in the control group was given daily one ounce of corn starch and one ounce of sugar in the form of pudding.

The diet, urine and faeces of the control and experimental groups were collected daily, during a 5 day experimental period. The diet and the excreta were preserved and analysed for calcium, phosphorus and nitrogen according to the methods adopted by Murthy *et al*¹. The results obtained for the metabolism of nitrogen, calcium and phosphorus are given in Tables I-III.

All the subjects in the experimental group retained a greater amount of nitrogen, calcium and phosphorus as compared with the control group. The results on statistical analysis showed that the differences (experimental minus control) in the nitrogen, calcium and phosphorus balances were significant at 5 per cent level. Our thanks are due to Mr A. N. Sankaran for the statistical analysis of the results.

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M. NARAYANA RAO
M. SWAMINATHAN
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Research Institute, Mysore.

TABLE I. *Mean daily intake, excretion and balance of nitrogen of children on rice and rice + M.P.F. diets*

| Diet | Calorie intake | Nitrogen intake (g.) | Nitrogen excretion | | | Nitrogen balance (g.) |
|-------------------------------------|----------------|----------------------|--------------------|-------------|------------|-----------------------|
| | | | Urinary (g.) | Faecal (g.) | Total (g.) | |
| Rice (Control) | 1060 | 2.961 | 1.806 | 0.702 | 2.508 | 0.453 |
| Rice + M.P.F. (Experimental) | 1049 | 6.089 | 3.926 | 1.201 | 5.127 | 0.962 |
| Difference | ... | 3.128 | 2.120 | 0.499 | 2.619 | 0.509 ± 0.188 |

TABLE II. *Mean daily intake, excretion and balance of calcium of children on rice and rice + M.P.F. diets*

| Diet | Calorie intake | Calcium intake (mg.) | Calcium excretion | | | Calcium balance (mg.) |
|-------------------------------------|----------------|----------------------|-------------------|--------------|-------------|-----------------------|
| | | | Urinary (mg.) | Faecal (mg.) | Total (mg.) | |
| Rice (Control) | 1060 | 287.2 | 78.8 | 155.0 | 233.8 | 53.4 |
| Rice + M.P.F. (Experimental) | 1049 | 565.6 | 160.2 | 210.9 | 371.1 | 194.5 |
| Difference | ... | 278.4 | 81.4 | 55.9 | 137.3 | 141.1 ± 48.6 |

TABLE III. *Mean daily intake, excretion and balance of phosphorus of children on rice and rice + M.P.F. diets*

| Diet | Calorie intake | Phosphorus intake (mg.) | Phosphorus excretion | | | Phosphorus balance (mg.) |
|-------------------------------------|----------------|-------------------------|----------------------|--------------|-------------|--------------------------|
| | | | Urinary (mg.) | Faecal (mg.) | Total (mg.) | |
| Rice (Control) | 1060 | 421.4 | 145.5 | 199.5 | 345.1 | 76.3 |
| Rice + M.P.F. (Experimental) | 1049 | 796.6 | 243.1 | 389.4 | 632.5 | 164.1 |
| Difference | ... | 375.2 | 97.6 | 189.9 | 287.4 | 87.8 ± 31.3 |

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INDIAN FOOD LAWS (*published in August 1954*) pp. v. + 220.

This volume summarizes all important details regarding the history, operation and enforcement of the food laws existing in different States in India, definitions, descriptions and chemical standards for articles of food including permissible additives, (colours, flavours and preservatives) and labelling of foodstuffs. The large number of tables on the comparative chemical standards prescribed for different food commodities in various parts of the country make the book useful for reference and guidance for the public analysts and the legal profession.

Price: Indian = Rs. 4-8-0 (*postage extra*); Foreign = 10 shillings.

TREATMENT OF NUTRITIONAL OEDEMA SYNDROME (*KWASHIORKOR*) WITH A LOW COST PROTEIN FOOD (INDIAN MULTIPURPOSE FOOD)

By V. SUBRAHMANYAN, T. R. DORAISWAMY, KANTHA JOSEPH, M. NARAYANA RAO AND
M. SWAMINATHAN

(Central Food Technological Research Institute, Mysore)

It is now generally recognised that nutritional oedema syndrome (*Kwashiorkor*) is widely prevalent among malnourished children belonging to the lower income groups of the population in India, and other South East Asian countries, Africa and South America¹. The syndrome has been shown to be caused primarily by a deficiency of protein in the diet, even though vitamin deficiencies may be associated with the condition^{1,2}. Various protein foods and protein hydrolysates have been used in the treatment of this condition¹⁻⁵. Subrahmanyam *et al*⁶ treated successfully a few severe cases of *Kwashiorkor* by the oral administration of a casein food fortified with calcium and B-vitamins. In all the above reports, the quantity of protein administered daily has varied from 50 to 70 g. per subject. Of late, it is being increasingly recognised that skim milk powder, though the cheapest protein food available so far for the treatment of protein malnutrition, cannot provide the basis for the large scale solution of the problem in under-developed countries, where skim milk powder is not available in sufficient quantities and has to be imported. It is obvious, therefore, that a search should be made for some cheap and familiar sources of protein rich food materials of vegetable origin readily available within the country and suitable for the treatment of the disease. Dean⁷ treated some cases of *Kwashiorkor* by the administration of cooked soyabean paste along with ripe banana. Venkatachalam *et al*⁸ reported that cooked Bengalgram dhal when used in quantities of 200-250 g. daily was effective in the treatment of protein malnutrition. Investigations carried out in the Central Food Technological Research Institute, Mysore, have shown that a low cost protein food (Indian multipurpose food) based on a mixture of low fat groundnut flour, (60 parts), Bengalgram dhal (20 parts) and skim milk powder (20 parts) and fortified with calcium and vitamins, is quite effective in the treatment of protein malnutrition. The present paper gives an account of the treat-

ment of a few cases of nutritional oedema syndrome with the low cost protein food mentioned above.

Dietetic history

Three subjects (children aged 2-3 years) suffering from nutritional oedema syndrome, were admitted as in-patients in the Holdsworth Memorial Hospital, Mysore. The diets consumed by the subjects consisted mainly of cooked rice or *ragi* and included only very small quantities of pulses and vegetables in the form of a soup but no milk products or animal foods. Diet survey carried out by the questionnaire method revealed that the daily intake of calories and proteins was highly inadequate to over a period of 1-2 years. The calorie intake was of the order of 500-600 calories and the protein intake about 10-12 g. per day. There was no history of previous illness of dysentery or any other debilitating disease. On enquiry, it was found that the subjects suffered from loss of appetite and distaste for food during a period of nearly three months prior to the onset of the disease. This was followed by diarrhoea for a period of 15-20 days, finally resulting in extreme weakness and oedema.

Clinical features and laboratory findings

In all the cases, generalised oedema was present. All the patients suffered from diarrhoea for over a period of 15-30 days. Two of the three cases (J, G) showed mild angular stomatitis, indicative of riboflavin deficiency. Two of the three (J, P) showed discolouration of the hair. The liver and spleen were not palpable in all the subjects. The conjunctiva was slightly pale in all the cases. One of the three subjects (J) showed crazy pavement of the skin over the legs and forearms while the other two (G, P) showed hyper-pigmentation with dermatitis over the leg and hips.

The urine in all the cases was normal except for traces of albumin. No parasitic ova or amoeba or cysts were found in the stools. The blood was analysed for haemoglobin, red blood cell

count and plasma protein contents. Haemoglobin was determined by the acid haematin method using Sahli-Hellige haemometer⁹ and the red blood cell count by using Neubauer's haemocytometer. Serological tests for syphilis were negative in all the cases. Serum protein analysis showed that the total protein and albumin content were very low and the globulin content was normal. The serum proteins were determined by the method of King¹⁰.

Treatment and results

All the cases admitted into the hospital with nutritional oedema syndrome were treated under routine hospital treatment for diarrhoea and oedema for a period of two days. No clinical improvement was observed during this period. Later, low cost protein food¹¹ (Indian multi-purpose food, formula C) was administered to the subjects, the daily dose being 4-5 oz. per child per day. The product was given in divided doses, four times a day as gruel sweetened with 2-3 teaspoonfuls of sugar. One ounce of the low cost protein food supplied the following

quantities of different nutrients: protein 11.5 g; calcium (as Ca) 210 mg; phosphorus (as P) 230 mg; thiamine, 0.4 mg; riboflavin 1.0 mg; nicotinic acid, 4.0 mg; vitamin A 857 I.U.; vitamin D, 71 I.U. A marked improvement in the general condition of the patients was observed within 8-10 days. Oedema began to subside from the 5th to the 7th day and complete disappearance of the oedema was noticed in about 3-4 weeks' time. The diarrhoea stopped at about the same time as the oedema began to subside. The dermatosis and hyperpigmentation began to heal by about the 10th day and completely disappeared between the 20th to 25th day. The subjects were kept in the hospital as in-patients for over a period of 6-8 weeks. The average loss of weight noticed at the time of disappearance of oedema was about 3 lb. and the total gain at the time of discharge was about 7-8 lb. All the cases showed healthy normal skin and good appetite at the time of discharge. The photograph of one of the subjects (child J) before and after treatment is shown in Fig. 1. The results are given in Tables I and II.



FIG. 1. Patient J on admission showing oedema of the legs and hands and skin changes (crazy pavement and hyperpigmented areas)



FIG. II. Same patient completely cured after treatment for 6 weeks with low cost protein food.

TABLE I. *Changes in the body weight of subjects of nutritional oedema syndrome treated with low cost protein food*

| Name of patient | J. | G. | P. |
|---|-----|-----|-----|
| Sex | Boy | Boy | Boy |
| Age (years) | 3 | 3 | 2 |
| Initial weight on admission (lbs) ... | 26 | 21 | 23 |
| Weight at the clinical disappearance of oedema (lbs) | 24 | 18 | 21 |
| Time taken for clinical disappearance of oedema (days) | 17 | 21 | 18 |
| Final weight at time of discharge ... | 30 | 22 | 27 |
| Total period of treatment (days) ... | 65 | 39 | 44 |

TABLE II. *Biochemical findings in cases of nutritional oedema syndrome before and after treatment with low cost protein food*

| Constituents of blood | Name of patient | | | | | |
|--|-----------------|-------|---------|-------|---------|-------|
| | J | | G | | P | |
| | Initial | Final | Initial | Final | Initial | Final |
| Haemoglobin (g/100 cc. blood) ... | 9.42 | 11.60 | 6.95 | 9.42 | 9.28 | 10.87 |
| Red blood cell count (10 ⁶ /cmm. blood) ... | 3.00 | 4.20 | 2.90 | 3.75 | 2.98 | 3.60 |
| <i>Serum</i> | | | | | | |
| Total protein% | 3.69 | 7.01 | 3.52 | 6.83 | 3.53 | 7.20 |
| Albumin% ... | 1.55 | 4.01 | 1.53 | 3.81 | 1.39 | 4.03 |
| Globulin% ... | 2.14 | 3.00 | 1.99 | 3.02 | 2.14 | 3.17 |
| Non-protein nitrogen% ... | 0.02 | 0.021 | 0.018 | 0.019 | 0.019 | 0.021 |

We are grateful to Dr (Miss) G. Gillespie and Dr (Miss) D. E. M. Pears of the Holdsworth Memorial Mission Hospital, Mysore, for their co-operation and help in the treatment of the patients in the hospital and for their keen interest in this investigation.

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BROCHURE ON HOME-SCALE FOOD PREPARATIONS SERIES

This brochure contains 66 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, *viz.*, the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 55 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation; 'Indian Sweet Series' giving methods of preparation and preservation of 3 kinds of typical Indian sweets; and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products.

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PLAN FOR THE MANUFACTURE OF INDIAN MULTIPURPOSE FOOD

By H. A. B. PARPIA, M. SWAMINATHAN AND V. SUBRAHMANYAN

(*Central Food Technological Research Institute, Mysore*)

Almost all the dietary surveys carried out in India have shown that the overwhelming majority of the people are malnourished. As against the caloric requirements of 2,600 proposed by the international organisations like the F.A.O. and the W.H.O., an average Indian gets 1,600 to 1,900 calories of food per day. The minimum daily protein requirement recommended by these organisations is 65 g. while in India the average consumption by a person is only 45 g. Almost 90 per cent of the protein in Indian diet is of vegetable origin, and therefore, not of high biological value as the animal proteins. Because of extremely low per capita income, an average Indian cannot afford to purchase the required quantity of protective foods such as milk, ghee, fish, meat, etc., except in those areas where these are available in plenty. All these facts indicate the need for developing a cheap, well balanced protein rich food for supplementing the diet of the people. Work was started in this direction at the Central Food Technological Research Institute, Mysore, and a cheap food of vegetable origin fortified with essential vitamins and minerals has been developed using the indigenous raw materials, *viz.*, specially prepared groundnut flour and Bengalgram flour. This is similar in almost all respects to the multi-purpose food which was developed by Barsook using the soyabean grits. About 1-2 oz., of this food would overcome the deficiencies in the general diet of the people. A considerable amount of investigations has been carried out by way of institution feeding and the value of this food has been well established.

After the development of the multi-purpose food, the Institute made efforts to popularise it and the results have been very encouraging. In order to make the food acceptable to Indian people, special recipes were prepared according to Indian taste incorporating multi-purpose food so that the product may be acceptable to the people without changing their food habits. This has helped considerably in making the food acceptable.

Some of the large industrial canteens have begun to realise that the general health and efficiency of their workers is directly dependent upon their diet and that multi-purpose food can play an important role in this direction. There are already indications from Latin American countries where the American multipurpose food was served to the workers indicating an increase of 10 per cent in the efficiency of the workers.

This Institute started with the manufacture of a small amount of multi-purpose food using the pilot plant equipment, but the demands are soon likely to go beyond this capacity. There are already a number of enquiries asking for a comprehensive plan to set up a multipurpose food manufacturing plant. With this in view, it has been thought advisable to publish a brief plan for one ton and five ton capacity units.

As the main raw material required is a by-product of the groundnut oil milling industry, it would be advisable to consider establishing a multi-purpose food plant in conjunction with one of the oil mills. The plan has been prepared on the basis of the experience gained and the conditions existing in Mysore region. Therefore, it will be essential to make certain alterations depending upon the conditions in other parts of the country, such as the cost of land, building, and facilities for obtaining raw material, transportation facilities, etc. The working capital is based on a certain assured turnover which will vary in different areas and would be lower if the turnover is large. The plant for the manufacture of one ton is designed in such a way that it would be expanded easily without too much additional expenditure, although to begin with it may not appear as efficient as the five ton plant.

Manufacturing Process

(1) *Cleaning of groundnut kernels:* The quality of the finished product is entirely dependent upon the quality of raw material. Therefore, it is very essential that it should be of good quality. All possible care is taken to remove shrivelled kernels and impurities like stones, etc. A screen shaker

would remove most of the dirt, while large pieces of stones and spoiled kernels can be removed by picking them on a conveyor belt. The broken material present are removed by a blast of air.

(2) *Roasting of groundnut kernels:* Cleaned kernels are lightly roasted in an open electrically operated pan roaster having a capacity of about one ton per eight hours working a day. Three such roasters are required as three tons of kernels will give one ton edible groundnut flour.

(3) *Removal of cuticle or testa:* The roasted kernels are allowed to cool and the testa removed mechanically by passing through a blanching machine. This work can also be done by hand for small scale operation. The attached cuticle material is separated from the kernels by air blast. If, on removing the cuticle it is observed that the kernels contain a number of spoiled and decuticled material, it should be picked again on a sorting belt.

(4) *Preparation of oil and cake:* The decuticled kernels are then crushed in a carefully cleaned expeller to obtain oil on the one hand and meal containing 8-10 per cent fat on the other. The oil thus obtained has better appearance than the general commercial grade. The white meal thus obtained is used in the preparation of multipurpose food.

(5) *Preparation of Bengalgram:* Split Bengal gram (*dhal*) is cleaned to remove grit and other impurities. It is then lightly roasted in an electrical roaster. The coffee roasters having a capacity of $\frac{1}{2}$ ton per eight hours working a day are quite adequate for the purpose.

(6) *Grinding of raw material:* Both the groundnut cake and the roasted split Bengal gram are ground separately in a carefully adjusted grinding mill to obtain grits of fairly uniform size, between 10 and 30 mesh. The groundnut grits are lightly roasted until a pleasant aroma develops.

(7) *Preparation of seasoning:* Condiments like coriander seed, black pepper, cinnamon, turmeric and asafoetida are mixed together in proper proportions and lightly roasted in the presence of a small amount of hydrogenated fat. The material thus prepared is finely ground.

(8) *Vitamin and mineral premix:* A mixture containing vitamin, A, D, thiamine, riboflavin and calcium phosphate is prepared in ground-

nut flour. Vitamins A and D, not being water soluble are added after dissolving them in hydrogenated fat.

(9) *The final mixing:* Groundnut meal grits (75 parts) and bengal gram grits (25 parts) and the vitamin and mineral premix are mixed together in a mechanical mixer. The prepared seasoning is added only during the manufacture of seasoned multi-purpose food. It is very essential to mix the whole material thoroughly, otherwise improper distribution of vitamins in certain cases may occur.

(10) *Packaging of finished product:* The finished product could be conveniently packed in 7 lb. and 28 lb. tin containers fitted with lever lids and tagger tops. For small retail sales it may be advisable to use $\frac{1}{2}$ and 1 lb. polyethylene bags.

Economic unit

It would be difficult to define the smallest economic unit for manufacturing the multipurpose food as local conditions influence the cost of production and distribution considerably. For a commercial enterprise, one has also to take into consideration the demand and the possibility of its increase. Yet, one could not consider a very large unit which could not be operated economically for years to come. Under the circumstances, it is felt that a one ton plant with provisions for expansion would be quite economical. A larger unit would, however, have several advantages if market could be found for the output. Therefore, an attempt has been made to compare a one ton unit with a five ton per day production unit which could perhaps be operated economically with the increase in demand of multipurpose food.

Marketing and distribution

As pointed out earlier, the demand for multipurpose food has been going up considerably and its value has been realised by various industrial canteens, hospitals, clinics, and public service organizations. It has also been found to be acceptable in certain rural areas. Therefore, the best way to popularise and market this product would be among the people who could derive the maximum benefit in their dietary from this food. A large number of enquiries have been already received for sole

PROPOSALS* FOR SETTING UP OF MULTIPURPOSE FOOD PLANTS OF 1 TON AND 5 TON CAPACITY PER DAY, 8 HOURS WORKING, 280 DAYS PER YEAR

| PARTICULARS | | | | | 1 TON PLANT | 5 TON PLANT |
|-------------------------------|---|--------------|---------------|-----------------|-----------------|------------------|
| Summary of the proposals | | | | | Rs. | Rs. |
| I. | Working Capital (considering the fact that there would be one complete turnover in 3 months) | | | | 1,25,000 | 5,00,000 |
| II. | Fixed Capital : Land and Building | | | | 95,000 | 2,00,000 |
| III. | Machinery | | | | 1,10,000 | 3,25,000 |
| | | | | | <u>3,30,000</u> | <u>10,25,000</u> |
| IV. | Staff salary per month (approximately) | | | | 1,725 | 3,000 |
| Break-ups for the above items | | | | | | |
| 1. | Fixed Capital Investment: | | | | | |
| | (a) Land in Mysore (the cost of land will vary depending upon the place where the plant is to be established) ... | | | | Rs. 15,000 | Rs. 40,000 |
| | (b) Building requirements : | | | | | |
| | | 1 ton plant | 5 ton plant | | | |
| | | Sq. ft. | Sq. ft. | | | |
| i. | Cleaning room | 3,200 | 6,400 | | | |
| ii. | Grinding and mixing room | 1,600 | 3,200 | | | |
| iii. | Raw materials and finished product storage | 1,300 | 2,600 | | | |
| iv. | Office accommodation, packing and despatch room | 500 | 1,000 | | | |
| | Total Built up area | <u>6,600</u> | <u>13,200</u> | | | |
| | Cost of construction at Rs. 12 per sq. ft. (approx) ... | | | 80,000 | | |
| | | | | | 95,000 | 1,60,000 |
| | | | | | | 2,00,000 |
| 2. | Machinery and equipment required: | | | | | |
| | (a) Equipment for cleaning, sorting and removal of cuticles | | | | 12,000 | 36,000 |
| | (b) Roasting machine | | | | 10,000 | 30,000 |
| | (c) Grinder for groundnut meal | | | | 7,500 | 22,500 |
| | (d) Grinder for pulses | | | | 7,500 | 22,500 |
| | (e) Mixing and screening equipment | | | | 10,000 | 30,000 |
| | (f) Bins and containers for storage and handling at various stages | | | | 10,000 | 30,000 |
| | (g) Weighing equipment | | | | 4,000 | 12,000 |
| | (h) Dust removal equipment | | | | 2,000 | 6,000 |
| | (i) Sundries and minor plant facilities | | | | 12,000 | 37,500 |
| | (j) Installation of equipment | | | | 7,500 | 22,500 |
| | (k) Drier (electrically heated) | | | | 10,000 | 30,000 |
| | (l) Installation of services (power, light and water etc.) ... | | | | 5,000 | 15,000 |
| | (m) Furniture for Plant and Office | | | | 2,000 | 6,000 |
| | (n) Laboratory equipment | | | | 10,000 | 25,000 |
| | | | | <u>1,10,000</u> | <u>3,25,000</u> | |

* 1. These production units make use of manual labour as much as possible, which is in keeping with the Labour Intensive Capital Formation Policy of the Government.

2. If the decuticling of roasted kernels is done mechanically, there will be a reduction of about 60% in the cost of labour.

3. Major capital expenditure such as the use of decorticating machine and expellers is not considered at all because shelled groundnuts can be obtained from a local oil mill. These are cleaned and returned to them for the extraction of oil. Only clean groundnut cake from the mill will be taken back for the manufacture of MPF. This practice will absolve the manufacturer from the necessity of finding market for the oil as well as high establishment expenditure.

4. The working capital requirement has been calculated taking into consideration the fact that there would be one complete turnover in 3 months.

5. If, on the other hand, it takes a longer period to realise the bills, the working capital requirement will correspondingly increase.

| PARTICULARS | | | | | 1 TON PLANT | 5 TON PLANT |
|--|-----|-----|-----|-----|----------------------------|---------------------------|
| Cost Estimates | | | | | | |
| 1. Cost of raw material per day: | | | | | | |
| (a) Groundnut meal (including wastage 5%) at Rs. 450 per ton | ... | ... | ... | ... | Rs. 293 (for 13 cwt) | Rs. 1,463 (for 3½ tons) |
| (b) Bengalgram <i>dhal</i> at Rs. 480 per ton | ... | ... | ... | ... | 192 (for 8 cwt) | 960 (for 2 tons) |
| (c) Enrichment with vitamins and minerals | ... | ... | ... | ... | 140 | 700 |
| (d) Spicing | ... | ... | ... | ... | 35 | 175 |
| 2. Cost of containers including labels | ... | ... | ... | ... | 200 | 1,000 |
| 3. Services: Power and Water | ... | ... | ... | ... | 35 | 175 |
| 4. Labour at Rs. 1-8-0 per day | ... | ... | ... | ... | 90 (for 60 men) | 270 (for 180 men) |
| 5. Supervisory staff expenditure | ... | ... | ... | ... | 72 | 125 |
| 6. Maintenance of equipment and Building | ... | ... | ... | ... | 25 | 50 |
| 7. Depreciation: Building at 5%, and Equipment at 10% | ... | ... | ... | ... | 54 | 145 |
| 8. Crating the tin at As. 6 per tin | ... | ... | ... | ... | 30 | 150 |
| 9. Interest on working and fixed capital at 5% | ... | ... | ... | ... | 59 | 192 |
| 10. Damage, Returns and Free Samples | ... | ... | ... | ... | 126 | 540 |
| 11. Educational Literature etc. | ... | ... | ... | ... | 75 | 150 |
| Total | | | | | 1,426 | 6,095 |
| Ex-factory cost of the Product per lb. (Approx.) | | | | | Re. 0-10-3 (64 nP.) | Re. 0-8-9 (55 nP.) |

agencies from different parts of the country and a number of individuals have been obtaining their supplies from the Central Food Technological Research Institute, Mysore. This indicates that sufficient amount of preliminary work has already been done which has proved that market for multipurpose food would not at all be difficult to find. In the near future, with the financial help of the Meals for Millions Foundation, U.S.A. and other public service organizations, an organized effort will be made to popularise the food in the rural areas in collaboration with the various Development Commissioners in-charge of the Community Projects and Extension Service Blocks, Block Development Officers and Project Executive Officers.

Marketing can also be organized through the

various State Co-operative organizations, All India Khadi and Village Industries Stores and various other organizations set up by the Government of India in addition to private agents who could be appointed in different parts of the country. If these sources of marketing are used, it would not be difficult to retail the product at an approximate price of 75 *naye paise* per pound.

The importance of manufacturing multipurpose food can hardly be over-stressed in a severely undernourished country like India. An organized effort through education of the people will go a long way in achieving the much needed popularity for multipurpose food so that the health of the people could be improved by using this cheap nutritious food.



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RETENTION OF ADDED ASCORBIC ACID IN CANNED JACK FRUIT DURING PROCESSING AND STORAGE

By B. S. BHATIA, G. S. SIDDAPPA AND GIRDHARI LAL

(Central Food Technological Research Institute, Mysore)

In the course of a systematic investigation of the stability of ascorbic acid in various canned products¹⁻⁵ the information regarding canned jack fruit (*Artocarpus Integrifolia*) was collected. The results are briefly discussed in this paper.

Materials and Methods

Jack fruit bulbs were canned in plain jam size cans (301×309) using sugar syrup of 50° Brix containing 0.5 per cent added citric acid⁶. Ascorbic acid was added at the rate of 50 mg. per 100 g. of the contents of the can. The cans were stored at room temperature (24-30° C) and 37° C and ascorbic acid estimated in triplicate samples by the xylene extraction method⁷ in the drained fruit as well as syrup after processing and different periods of storage.

Results and Discussion

It was observed that the retention of ascorbic acid after processing was about 80 per cent. In the case of other canned fruits, retention of ascorbic acid has been reported to be 91.2-96.5 per cent in pineapples¹, 90 per cent in *Badami*

and *Raspuri* mangoes, 80.6 per cent in guavas⁴ and 84-86 per cent in Coorg oranges⁵. Thus, retention after processing in the case of canned jack fruit is close to that in the canned guava.

During storage at room temperature (24-30° C) for 24, 48 and 64 weeks, the retention of ascorbic acid was 48.9, 36.6 and 29.9 per cent respectively. At 37° C, the corresponding values after 24 and 48 weeks were 28.0 and 1.7 per cent respectively. The initial ascorbic acid content was 55.2 mg./100 g. The pH of the cut-out syrup was 4.55 and the total titratable acidity 0.30 per cent as anhydrous citric acid. There was not any marked change in pH or total acidity of the product during storage. Siddappa and Bhatia^{2,5} reported retention values of 86, 84 and 62-65 per cent in Coorg oranges, *Sathgudi* oranges and in mangoes canned alone or in combination with other fruits after a storage period of more than one year at room temperature. Retention of 72.3 per cent has been reported in canned pineapple after about 12 months' storage at room temperature. Thus, stability of ascorbic acid is rather low in canned jack fruit when compared with other fruits like Coorg oranges, *Sathgudi* orange, mango and pineapple.

The cans stored at room temperature for 64 weeks were normal with respect to vacuum, headspace, colour, texture, taste and aroma, while those stored at 37° C had developed light brown to brown colour and slight cooked taste even after 24 weeks storage.

Summary

1. In canned jack fruit fortified with 50 mg. per cent of ascorbic acid, retention of ascorbic acid after processing is 80 per cent.

2. During storage at room temperature (24-30° C) for 24, 48 and 64 weeks, the retention of ascorbic acid was 49, 37 and 30 per cent respectively. At 37° C the corresponding values after 24 and 48 weeks were 28 and 2 per cent respectively.

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3. Stability of ascorbic acid is rather low when compared with other commercially important fruits.

Acknowledgment

The authors are highly grateful to Dr V. Subrahmanyam, Director of this Institute, for his keen interest in this investigation.

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SCIENCE NOTES

A SIMPLE METHOD FOR ASSESSING THE EXTENT OF INSECT DAMAGE IN COMMERCIAL SAMPLES OF STORED GRAINS

Recent work from this Institute by Subrahmanyam *et al*¹ has shown that with the progressive infestation of wheat as revealed by kernel damage, there is also a rise in the concentration of uric acid in the damaged material. The above experiments were carried out under controlled conditions in the laboratory and it was, therefore, decided to investigate whether this observation can be extended to food grains infested under uncontrolled commercial conditions. The results of the preliminary investigations carried out with infested Bengal gram samples are reported here.

A number of samples of infested Bengal gram (*Cicer arietinum* L) all infested by *Bruchus* sp. were obtained from the local market. The kernel damage was determined according to Subrahmanyam *et al*¹ and was found to vary from 8-50 per cent in the different samples. Samples with more than 50 per cent kernel damage could not be obtained. The uric acid in the samples was estimated according to Subrahmanyam *et al*¹ with slight modifications as follows: 100 g. lots of the material were powdered. 0.5 g. of the thoroughly mixed sample was weighed into a flask. 400 ml. of water and a few c.c. of CHCl_3 were added. The mixture was allowed to stand overnight and then mixed well in a Waring blender for 2 minutes. It was then centrifuged and decanted. To 50 ml. of the centrifugate were added 5 ml. of 10 per cent sodium tungstate and 5 ml. of $2/3 \text{ N-H}_2\text{SO}_4$ to precipitate

the proteins. The mixture was allowed to stand for 15 minutes and filtered. 10 ml. of the clear filtrate were used for determining the uric acid present according to the method of Benedict and Franke². The above determination was carried out with clean, uninfested Bengal gram also. No uric acid could be detected in the uninfested samples. The variation of the uric acid present in the samples with percentage of kernel damage is given in the accompanying table.

TABLE. *Uric acid content and kernel damage in infested Bengal gram*

| Sample | Kernel damage by weight (%) | Uric acid present in infested Bengal gram (mg./100 g.) |
|--------|-----------------------------|--|
| 1 | 8.0 | 143.0 |
| 2 | 19.0 | 341.7 |
| 3 | 37.5 | 614.6 |
| 4 | 45.0 | 693.5 |
| 5 | 50.0 | 945.9 |

From the results it will be seen that with the increase in the degree of infestation as revealed by kernel damage, there is an increase in the uric acid content of the infested material. The above data are of interest especially in assessing the degree of unhygienic quality of infested products due to the presence of insect excreta. The uric acid content of the product appears to

be a good index of the damage suffered by the material. Further, this method is simpler than the method based on insect-fragment counts hitherto available for assessing insect damage in grains and flours³. The application of this method for assessing the degree of unhygienic condition in other infested foodgrains is in progress.

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GOOD SANITATION PRACTICES REDUCE CLEANING TIME AND IMPROVE BAKERY PRODUCTS*

A clean bakery is good business because it creates customer confidence, results in improved quality of the finished product, reduces the accident potential and increases the efficiency of employees.

A sound sanitation programme is dependent upon proper building maintenance, good storage practices and good house-keeping habits. It should include rodent-proofing the building, inspection of all incoming ingredients, a frequent turnover of materials, proper storage and refrigeration facilities, and frequent cleaning of floors, ingredient containers and machinery.

Unclean equipment is apt to impart a stale, rancid taste to the finest product. The consumer calls this a 'bakery taste' and promptly boycotts the offending product. Custard-making equipment may cause serious illness unless properly cared for. Most cleaning operations are readily disposed of by following a simple routine, but at times, specific problems may require the skill and experience of trained sanitation experts.

The good cleaning techniques described below not only improve sanitation but reduce cleaning time.

Visitors to a bakery which probably operates the largest house-to-house operation in the United States see glistening white equipment and immaculate production areas. All employees share in the responsibility of carefully protecting all ingredients and products made to keep them sanitary.

It is reported that equipment can be cleaned with a steam nozzle in less than a third of the time that was previously required with a brush and bucket. A steam vapour cleaner is used to clean kettles, mixing bowls, floors and sugar glaze from donut racks. It is also reported that the new method cleans three racks in less time than previously was required for one. It took 15 to 20 minutes instead of 1 to 1½ hours.

If it is necessary to fumigate to control insects, it should be done by trained specialists. A solution of hypochlorite at a concentration of 200 parts per million, is the sanitizing agent most commonly used in the food industry. The quick acting type of hypochlorite should be used. All cleaned equipment should be washed with sufficient water to remove all traces of the cleaning solution.

An industrial vacuum cleaner is a necessity to keep the bakery in shipshape condition. It is practically impossible to brush out accumulations in various parts of equipment such as the flour blender and overhead proofer. To be effective for use in a bakery, the vacuum cleaner must be equipped to pick up crumbs, spilled flour, and dough. The filter bag, enclosed in the tank, should be removed and cleaned often so as to prevent the cloth bag from becoming clogged with moist flour.

Mold growth in the fermentation room of one bakery had become a serious problem. Mortared joints between the glazed tiles were

* Digested from the November 1956 issue of *Bakers Review*. Copyright 1956 by William R. Gregory Co. : Reprinted with permission from the United States Technical Co-operation Mission to India.

black with mold. Washing with chlorinated cleaner had proved ineffective, primarily because humidifier ducts had not also been cleaned at the same time.

An alkaline detergent with a working pH of 12, was used in the plant to clean the bread cooler air conditioner. The walls, floor and ceiling were scrubbed, and the air ducts were taken down and cleaned. After cleaning, the walls were rinsed with fresh water and with a solution of a quarternary ammonium compound which has a lasting mold preventive ability.

The initial cleaning was followed up by a continuing programme—weekly cleaning with the alkaline solution, and treatment of the cooling water every three days with the quarternary ammonium compound.

This method has proved so effective that the mortar between the glazed tiles has almost returned to its original white colour and the walls are cleaned only every two weeks.

Another bakery cleans steel like mesh bread

conveyor belts, tightly packed with bread crumbs, by immersing the chains in a heavy duty alkaline detergent solution, boiling for about a half hour. Cleaning is followed by hose rinsing. Chains come out perfectly clean with no hard brushing required.

One baker used to dismantle his donut cooling tunnel and immerse the conveyor chains in a boil-out tank. This method took more than 60 hours to dismantle, clean and reassemble. He now uses a mobile spray cleaning unit with a medium duty alkaline detergent solution at 2 ounces to the gallon of water, at 165°F. The worker sprays chains and sprockets while the machine is running. After thorough cleaning, the conveyor is given a pressure hose rinse and blown down with air.

To get the most out of sanitary maintenance, a supervisor should be employed full time. Employees should be well trained and quality cleaners should be furnished.

REVIEW SECTION

ROLE OF INTESTINAL MICROFLORA IN HUMAN HEALTH AND NUTRITION

By V. SUBRAHMANYAN, V. SREENIVASAMURTHY, K. KRISHNAMURTHY AND M. SWAMINATHAN

(Central Food Technological Research Institute, Mysore)

The relation of intestinal bacteria to optimum nutrition and health of human beings is one of the important problems in nutrition and a satisfactory understanding of this problem will help considerably in the planning of diets aimed at promoting optimum health. The alimentary tract, being open to infection through media of food, drinks and air, always carries innumerable microorganisms. The common groups of organisms found in the mouth are *lactobacilli*, *enterococci*, *staphylococci*, *spirochetes* and *actinomycetes*. Stomach contents being highly acidic are generally free from bacteria. Proximal part of the small intestine also remains almost sterile. The distal part carries a few microorganisms mostly of the coliform group. Large intestine is by far the most heavily infested part of the tract and the inhabiting flora cover a wide range

of species. It has been estimated that bacteria constitute nearly two-thirds of the dry weight of the faecal matter¹. Metchnikoff was one of the earliest workers who expressed the view that many of the ailments of the body were due to the absorption of toxins produced as a result of decomposition of proteins by the putrefactive types of organisms and that such reactions could be controlled by the use of fermented milks containing predominantly lactic acid bacteria. These views were received with great interest as he pointed out that the good health and longevity of the Bulgarians was due to their habit of drinking fermented milk containing predominantly the lactic acid organism, *L-bulgaricus*. The later observations of Smith² and Kopeloff³ that the types of microorganisms present in the alimentary tract could be changed predominantly

to *acidophillus* species by ingesting large quantities of acidophillus milk, lent further support to the theory of Metchnikoff².

The effect of variation in the composition of diet on the intestinal microflora

A fair amount of work has been done since then by different workers on the effect of variation in the composition of the diet on the intestinal microflora^{5,8}. The results showed that in general meat or high protein diet induced the growth of proteolytic flora and a high carbohydrate diet favoured the growth of saccharolytic organisms. Johnson *et al*⁷ investigated the effect of various carbohydrates on the intestinal microflora of chick. They found that dextrin stimulated the development of coliform flora, while lactose promoted the development of lactic acid bacteria. The most marked effect noted in the case of sucrose diet was a depressing action on faecal coliforms. In a similar study on rats, Nath *et al*¹⁰ reported that lactose produced the maximum increase in both the aerobic and anaerobic plate count as well as in the number of coliforms and lactics as compared with dextrin and sucrose. The ratio of aerobic to the anaerobic plate count was highest on a dextrin diet and lowest on a lactose diet. Nath *et al*¹⁰ found that the number of enterococci in the ceca of rats was slightly lower in the animals fed on diet containing butterfat than that found in the ceca of animals receiving corn oil. This was attributed to the high oleic acid content of corn oil which had a stimulatory influence on the growth of microorganisms. They further recorded a decrease in the coliform, total aerobic and anaerobic counts on increasing the fat content of the diet. Balakrishnan and Rajagopalan¹¹ studied the effect of incorporation of three types of fats viz., butter fat, coconut oil and groundnut oil, on the intestinal flora and found a preponderance of coliforms in the butterfat group. Gall *et al*¹² reported that mice fed on a stock diet had a higher bacterial population per gram of cecal contents and per cecum as compared with mice fed on synthetic diet. Subrahmanyam *et al*¹³ found that the bacterial counts in the cecal content and faeces of albino rats fed on stock diet containing fair amount of indigestible matter was considerably higher than that observed in

animals fed on a rice diet. They also observed that substitution of rice in the rice diet by red gram *dhal* to an extent of 60 per cent considerably increased the number of coliforms and anaerobes in the cecum.

Metabolic products of intestinal bacteria

The harmful effects of microorganisms are generally considered to be due to the toxins produced by them. Considerable amount of information is available in the literature on the nature and action of toxins produced by pathogenic bacteria like *Shigella dysenteriae*, *C. diphtheria*, and *Cl. botulinum*¹⁴. Very little information, however, is available on the nature of toxins produced by the bacteria normally inhabiting the intestinal tract. The other type of metabolic products formed by the action of intestinal bacteria on the undigested food residues are amines, methylmercaptans, hydrogen sulphide, alcohols, organic acids, indole, skatole, phenol, cresol and gases like methane, carbon dioxide and hydrogen¹⁵. Some of the amines, e.g., histamine, obtained from histidine is known to have profound physiological effects. Determination of the concentration of the above constituents in the intestinal contents may serve as an index of the intestinal fermentation and putrefaction, and this may lead to an evaluation of the usefulness or otherwise of the intestinal flora. There is some evidence that some of these may alter the intestinal motility and may irritate the intestines, resulting in the secretion of greater amounts of mucus. Other symptoms like headache and biliousness may also be caused by the absorption of toxins liberated by the putrefactive organisms present in the colon as experienced in constipation.

The Role of intestinal bacteria in the synthesis of B-vitamins

The nutritional significance of intestinal microorganisms was indicated by earlier workers (Cooper¹⁶, Theiler *et al*¹⁷) and during recent years it has been established that all the vitamins of the B-complex, as well as vitamin K, may be synthesised to varying extents in the alimentary tract of animals as a result of activity of these organisms^{6, 18, 19}. In addition, information has been obtained concerning the effect of differ-

ent carbohydrates on the intestinal synthesis of B-vitamins²⁰. It is fairly well known now that irrespective of what B-vitamin is investigated, its requirement is reduced when carbohydrates like dextrin or starch are used in the diet. Lactose sometimes favours the production of some of the B-vitamins but glucose, sucrose or other readily assimilable sugars are without effect in this respect²¹⁻²⁹. The cecum has been postulated to be the main site of vitamin synthesis by intestinal microorganisms^{26, 30-33}. Najjar and co-workers³⁴⁻³⁶ have reported the synthesis of thiamine, nicotinic acid and riboflavin in the intestinal tract of humans when diets rich in dextrimaltose were used. They also found that riboflavin was synthesised in much greater amounts than thiamine. Ellinger and Benesch³⁷ have clearly established the biosynthesis of nicotinamide in the human gut. They also reported that when human faeces obtained by cecectomy was incubated under aerobic conditions, a considerable synthesis of nicotinic acid took place, while when the faeces was incubated anaerobically the organisms destroyed two thirds of the nicotinic acid present in the original medium. Najjar *et al* have also produced evidence for the synthesis of nicotinamide by bacteria in the intestinal tract. McCall *et al*³⁸ and Sarma *et al*³⁹ have obtained evidence that pyridoxine may also be synthesised in the intestinal tract of rats under certain conditions. Oppel⁴⁰ found that the total excretion of biotin in human beings was three to six times that present in the diet. Najjar and Holt^{34, 36} reported that the bacterial synthesis of both biotin and folic acid is quite high in the case of human beings. Dinko *et al*⁴¹ found in young adults that the total urinary and faecal output of para-aminobenzoic acid, biotin, folic acid, and pantothenic acid exceeded the dietary intake. This was not the case with thiamine, riboflavin, pyridoxine and nicotinic acid. Ramasastry *et al*^{41a} reported that in a number of subjects studied, larger amounts of riboflavin was excreted in the urine than the dietary intake. They observed that this was suggestive of microbial synthesis of vitamin in the intestines and much of the vitamin thus synthesised seemed to be available to the human organism. Balakrishnan and Rajagopalan^{41b} observed in their studies on children that curds primarily

led to a better thiamine nutrition status through increased synthesis of the vitamin.

Effect of antibiotics on intestinal microflora and on the growth of animals and children

Investigations on the action of different antibiotics on the intestinal microflora and on the growth of animals and children have given us a new insight into the possible role of intestinal microflora in relation to the growth of animals. Briggs *et al*⁴² obtained a better growth response in rats in a complete diet when sulphasuxidine was added. Moore *et al*⁴³ found that streptomycin and sulphasuxidine gave growth increases of 10-30 per cent in the presence of folic acid. Harned *et al*⁴⁴ in a study of the pharmacology of aureomycin reported that 2500 p.p.m. in the diet increased the growth of chicks and gave them a healthier appearance. The recognition that antibiotics increased the growth rate of animals, stimulated interest in the use of antibiotics in promoting the growth of children. Perrini⁴⁵ administered 25 mg. of aureomycin per Kg. body weight to 10 premature children for 10 days and observed an extra increase in weight of 8 per cent over the control. Robinson⁴⁶ studied the effect of 50 mg. of aureomycin per day in controlled trials on premature children and reported that all the children receiving aureomycin gained more weight than the control. Carter⁴⁷ studied the effect of 150 mg. of aureomycin per day in children, aged 1-3 years and found that the group receiving aureomycin gained more weight than the control. A large scale experiment with poorly developed and undernourished children was conducted by Scrim Shaw and Guzman⁴⁸. They noted that children receiving 50 mg. of aureomycin per day increased in weight and height to a greater extent over the control in an eighteen month period. Several studies have been made on the intestinal microflora in an attempt to correlate changes in the bacterial population with the growth response induced by antibiotics. Moore *et al*⁴³ noted that streptomycin decreased the coliform and the enterococci counts in the ceca and increased the lactobacilli and yeasts. They concluded that the growth stimulation due to streptomycin might be due to inhibition of intestinal bacteria that are either producing toxic

material or rendering certain dietary vitamins unavailable to the animal: Sieburth *et al*⁴⁹ noted a marked effect of penicillin and terramycin in decreasing the counts of *Cl. perfringens* in the ceca of turkeys and the faeces of pigs and suggested that the antibiotics promoted growth by preventing enterotoxemia. This possibility finds support in the observations of Kunkel⁵⁰ that aureomycin tends to decrease enterotoxemia in sheep and in the findings of Merchant⁵¹ that enterotoxemia in sheep is caused by *Cl. perfringens*. Other studies with pigs⁵² involving several antibiotics showed that although the count of *Cl. perfringens* decreased in all groups, no apparent correlation existed between rate of gain and the numbers of *Cl. perfringens*. This might probably be due to development of resistance by the organism to the antibiotic under certain experimental conditions. On the other hand, Peterson and Johnsson⁵³ noted that the count of *Cl. perfringens* in the faeces of rats increased during the first few days of aureomycin feeding. The count in the cecum and ileum after 6 weeks decreased on a sucrose diet and unchanged on a dextrin diet although significant increases in growth occurred in both diets. Anderson, Cunningham and Slinger⁵⁴, however, found that penicillin increased the total cecal coliform count although *E. coli* itself was reduced. The increase in coliform count was ascribed to atypical penicillin resistant strain. Enterococci was reduced by penicillin, while lactobacilli, aciduric, anaerobic and aerobic organisms were increased. Subsequently the same authors⁵⁵ found that terramycin which was effective in increasing the growth of turkeys, produced similar changes in cecal flora and reduction of the pH of the cecal contents.

It is evident from the above account that the action of antibiotics in increasing growth is related apparently to its effect on the bacteria in the intestinal tract. This rests primarily on the following observations: (1) antibiotics of widely varying chemical structure produce similar effects and (2) the ineffectiveness of antibiotics in increasing growth in the germ free animals⁵⁶. The probable mechanisms involved in the growth stimulation would appear to be the following: (1) Inhibition of bacteria which compete with the host for essential nutrients and

(2) inhibition of microorganisms which may be deleterious, because of toxic compounds of unknown nature produced by them and which may have a depressing effect on growth.

Intestinal microflora and antibiotics in hepatic disorders of dietetic origin

Recent investigations have shown that apart from the nutritional effects, the intestinal microflora may be involved either directly or indirectly in certain liver disorders induced by dietary means. Gyorgy *et al*⁵⁴ reported that rats receiving a low protein diet in which baker's yeast was the source of protein, developed necrosis of the liver which could be prevented by feeding either methionine, cystine or vitamin E. They made the interesting observation that the necrosis was greatly reduced and delayed, although not completely prevented by high levels of aureomycin. Gyorgy *et al*⁵⁸ have postulated that the mechanism of this effect probably lies in the inhibition of the growth of toxin-producing bacteria in the lower intestines. Support for such a view comes from the observations that liver necrosis occurs mainly in the left lobe of the rat liver which derives its portal circulation from the large intestines and the stomach. In a later paper^{58a} he concludes that the beneficial effect of antibiotics may be due to a delay in the depletion of substances essential for normal hepatic function. In the same year Lucky, Rayners, Gyorgy and Forbes^{58b} reported the occurrence of normal liver tissue in germ-free animals as against the death of all but one, of the conventional rats on the same necrogenic diet. These results again implicate the intestinal microflora in the etiology of necrosis of the liver. Gyorgy⁵⁹ also found that aureomycin and other antibiotics exert a lipotropic effect, decrease in the incidence of cirrhosis and increase in the growth rate when fed to rats on a high fat, low protein, choline free diet. The favourable effect of the antibiotics has been attributed to its action in reducing the number of intestinal bacteria and thus preventing the destruction of the lipotropic factors present in the diet. In this connection the results of de la Huerga and Popper⁶⁰ are of interest for they could show a reduction in the destruction

of choline by feeding aureomycin. That hepatic coma is due to intestinal intoxication has been suggested by Phear and coworkers.^{50a}

Intestinal microflora in relation to etiology of sprue and pernicious anaemia

Sprue: French⁶¹ considered specific infections as one of the causes of tropical sprue though there is no clear evidence. According to this author, the essential functional disturbance in a sprue syndrome appears to be a generalised delay in absorption from the small intestine due to an increase in the secretion of mucus and loss of motility. Such a delay must lead to the presence of a rich pabulum favourable for extravagant growth of intestinal bacteria, especially in cases with achlorhydria. Although direct evidence is lacking yet it is clear that faecal flora is disturbed with increased putrefactive organisms. But whether these flora stimulate mucus secretion or not is not clear. A factor in the diet, either wheat gluten, rancid fat, or possibly even bacterial toxins from an acute intestinal infection cause an irritation of the small intestine. Functional changes in the small intestine result in the development of a bacterial cycle which may prolong the condition indefinitely. The only evidence in support of this theory is the marked improvement in the pathological symptoms after the administration of chemotherapeutic agents.

Pernicious anaemia: Theory of pathogenesis as the cause of anaemias is put forward by many workers. Cameron and coworkers⁶² after reviewing the subject of anaemia concluded that the anaemia was probably due to a stagnation of intestinal contents and the absorption of toxic substances. The observation⁶³ that anaemic rats which had developed a diverticulum in the small intestine survived longer with aureomycin, supported the views of Cameron⁶⁴ and associates. In cases of both pernicious anaemia, in relapse and nutritional macrocytic anaemia, good results were obtained by oral administration of aureomycin and not by injection of the antibiotic. Foy and coworkers⁶⁴ recorded good responses in two anaemic patients who were treated with penicillin. According to Ungley⁶⁵,

gastric atrophy leads to pernicious anaemia in two ways: '(a) loss of Castles' intrinsic factor leads to defective absorption of vitamin B₁₂ and so to depletion (b) loss of free hydrochloric acid reduces the antiseptic action of gastric juice. The contents of the upper intestines lack peptic predigestion. Moreover, the small amounts of gastric juice with which food is admixed are deficient in substances that bind vitamin B₁₂ and render it unavailable to certain bacteria. In this abnormal medium microorganisms flourish and produce the postulated toxic or inhibitory factor. In the initial stages this inhibitor is detoxicated by some enzyme systems of which folic acid or vitamin B₁₂ or both, form a part. The increased need for detoxication leads to an increased demand for one or both vitamins, stores of which are gradually depleted. When depletion reaches a certain level, detoxication fails and the animal suddenly becomes anaemic and ill.'

Enteric hypersensitiveness

Involvement of intestinal microorganisms in enteric hypersensitiveness has been suggested by Urbach⁶⁶ and Gottlieb⁶⁶. Urbach showed that the allergen is sometimes formed as a result of the action of pathogenic bacteria of the intestines on the ingested proteins. Enteric hypersensitiveness is an interference with normal colonic rhythm, possibly constipation, and a train of ensuing physiological disturbances. Most important of these is the absorption of toxic products resulting from bacterial metabolism. When their concentration is sufficient to overwhelm the detoxicating function of the liver they pass into the general circulation and give rise to various clinical effects. These may include certain types of chronic headaches associated with chronic constipation, cases of 'toxic vertigo' and other conditions in addition to such local intestinal effects as chronic functional diarrhoea and the so called irritable or unstable colon or 'neurogenic colitis'. The discovery of this mechanism has practical therapeutic significance for, in such cases we can speedily abolish the allergic symptoms by treatment directed towards altering the pathogenic flora, by such measures as diet, administering *Bacillus acidophilus* preparations etc.

Effect of spices on intestinal flora

The efficacy of several plant materials in the cure of intestinal infections, has been known in India since a long time⁷¹. Even today extracts of garlic, *ajowan*, ginger, pepper etc., are being used as household medicine to cure many of the intestinal ailments. Asafoetida has the reputation of possessing many medicinal properties and is still being employed in indigenous medicine. In recent years considerable attention is being paid to the natural materials to find out the nature of the active principles responsible for curing diseases. De and Subrahmanyam⁶⁷ and Bose *et al*⁶⁸ have determined the bactericidal properties of essential oils present in various spices and other aromatic substances commonly used in the indigenous system of medicine. Ramaprasad and Sirsi⁶⁹ have reported the antibacterial property of two fractions of turmeric. Antibacterial property of asafoetida and its usefulness in reducing the number of intestinal microflora have been reported by Sreenivasamurthy and Sastry⁷⁰. It is a matter of common experience that high pulse diet will lead to intestinal discomfort. In their studies with albino rats on high pulse diet Subrahmanyam *et al*¹⁸ observed a great increase in the count of anaerobic bacteria in the ceca. They also found that this abnormal increase could be controlled by incorporating garlic in the diet. These observations throw some light on the possible mechanism of action of these spices.

It is evident from the above account that the microflora inhabiting the intestines play a vital role in the maintenance of normal health of the host. Some may exert a beneficial effect by helping in the biosynthesis of B. group vitamins. Many others may affect adversely the health of the host either by depriving it of the essential growth factors or by impairing the absorption of essential nutrients or by producing certain toxins which may be absorbed and thus induce some clinical symptoms. As we learn more about the intestinal flora, we will be able to control both the beneficial and the detrimental types of organisms and to compensate for changes which we cannot control. In India, long before the advent of modern antibiotics, many of the naturally occurring spices and condiments have been used in the treatment of many of the intestinal disorders which predispose the individual

to a deficiency state. Available evidence would show that many of the common spices and condiments contain antibacterial principles which will have a controlling influence on the intestinal bacteria.

It is important to note that the action of these spices and aromatics, as judged by the reports available in the literature on Indian system of medicine, is out of proportion to their antibacterial activities. It is possible that by increasing the secretions of the digestive juices, they may facilitate better digestion and absorption of the food ingested. It may even be, by stimulating the peristaltic movements of the bowels, they may help in voiding the undigested and unabsorbed food which would otherwise form a good substrate for microorganisms inhabiting the intestines for the production of toxic substances. However, the mechanism of action of these spices which, by long experience, have, undoubtedly been found to have beneficial effects on the human system still remains to be unravelled.

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Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during March 1957 are given below:

S (IS) 200 (147)

Pepper, by T. N. Ramachandra Rao, (March 9, 1957). Pepper (*Piper nigrum* L.) is one of the most ancient crops of South-West Coast of India and though India once held the pride of place in pepper production but in recent years the East Indies have deprived India of its place and are threatening the export trade. The World's production for 1955-56 was 60,000 tons shared almost equally by India and East Indies. The acreage and production in India for the year 1955-56 were 2,00,000 acres and 26,000 tons. Of this, nearly 13,000 tons is exported bringing an annual revenue of 5 crores of rupees. There are about a dozen well-known varieties cultivated in India, but only four of them are good yielders, viz., *Kallu Valli*, *Balan-kotta*, *Vally* and *Kotta Valli*. There are two field pests on pepper, one is a fungus *Colletotrichum* and the other a beetle. These cause great damage to the crop in the rainy season. The dried black pepper on storage and during shipping regains moisture rapidly and when the moisture level increases to more than 13-14 per cent, the spoilage takes a heavy toll. This spoilage is mainly due to fungi which are chiefly: *A. niger*, *A. oryzae* and *A. glaucus*. Therefore, it is imperative to dry the pepper to a moisture level of 10.5 per cent. The presence of spore forming thermophilic bacteria on pepper, which cause gas formation, off-flavour and discolouration, are causative in spoiling the canned meat product, where pepper is used as flavouring agent. The spoilage due to these causal organisms can be controlled by treating the pepper with formalin or quater-

nary ammonium compounds. The speaker then suggested that there is a possibility to combat the spoilage by using some systemic fungicides, thereby, inducing resistance in the pepper berries. Further there is a great need for analysis of our pepper varieties and compare them with foreign samples in order to improve our pepper export, and also to establish proper standards.

The talk was then followed by an interesting discussion, where a number of questions were raised. It was felt that at present we have no adequate standards for, varieties and trade grades of our pepper, which are exported, therefore such constituents should be determined which could be taken up for standardization. The problem of adulteration should be more scientifically tackled. Proper methods of collection, handling and storage of pepper should be employed so as to eliminate microbial infection. Efforts in the direction of using mechanical washing and drying equipments are necessary to effectively control the final moisture percentage of pepper. Moisture-proof godowns and floorings would largely eliminate fungus infection in stored berries. The problem of controlling moisture per cent of pepper during shipping may have to be studied in detail, and use of suitable packaging material such as polyethelene laminated jute bags may be tried. The residual effects of systemic fungicides should be established before recommending their use.

The president reviewing the discussion added that the pepper waste, e.g., 'Varagu', stalks, rejections and shells could be utilized for extracting essence, which can possibly be exported. The fungus

infested pepper could be recovered by some treatments. Some mechanical method could be evolved to produce white pepper and the by-product may be utilized in extraction of essence. He then concluded with the observation that in view of the growing enquiries from trade, it may be necessary to set up a small unit in the Institute to deal with pepper analysis, standards, storage and utilization of waste products.

S (IS) 201 (148)

Stability of Vitamin B₁₂ in proteolysed liver extract, by V. Srinivasamurthy, (March 16, 1957). The problem of stability of the vitamin during storage is important for two reasons, firstly, the liver preparation are used long after they are actually prepared and secondly their efficacy in the treatment of pernicious anemia is largely dependent on its vitamin B₁₂ content at the time of administration. During the course of this investigation it was observed that liver digests stored in half-filled bottles lost nearly 87 per cent of their initial potency during a period of six months storage. Use of nitrite and metabisulphite was only of limited value since the digests stored with these salts lost about 44 per cent of the vitamin potency. Cyanide was found to exert remarkable stabilising effect, but the use of cyanide as a stabiliser being too hazardous to be recommended, investigations were continued to find an alternative. In the next series of experiments it was observed that the digests stored in vacuum or in nitrogen atmosphere or in bottles filled without air space and sealed maintained their potency appreciably well. These results

indicated air to be one of the factors adversely affecting the stability. Cyanide ion however, stabilised the vitamin in spite of air space in the bottle. The action of cyanide being only to convert, hydroxocobalamin to cyanocobalamin, the result suggested that hydroxocobalamin may be the labile fraction.

A more conclusive evidence to adduce instability to hydroxocobalamin fraction was obtained by storing the digest under different conditions and following hydroxo and cyanocobalamin changes in the digests during storage, and the speaker described the method worked out in this laboratory for the estimation of hydroxocobalamin in liver extracts. The results of the storage studies showed that both cyano and hydroxocobalamin concentrations in digests stored in half filled bottles decreased considerably. In bottles wrapped up with black paper, only hydroxo analogue lost its potency, while the cyano fraction remained stable. This indicated that the loss in potency was due to the instability of the hydroxoform. In digests stored under nitrogen but exposed to light, it was found that the vitamin potency although in the hydroxoform remained stable. Similar results were recorded in the digests stored in ampoules. These results showed that light converts the cyanoform to its hydroxoform and the light of different ranges of wave lengths did not show appreciable differences in effecting this conversion. Since hydroxocobalamin in presence of air loses its potency, maximum protection to the vitamin is given by storing the digests in vacuum or in nitrogen atmosphere.

The speaker pointed out an interesting phenomenon which appeared to have bearing on the problem of stability. Pure cyanocobalamin on exposure to light gets promptly converted to hydroxocobalamin and on storing in the dark, cyanide ion combines with the hydroxoform to give back cyanocobalamin. While with liver digests, cyanocobalamin is being converted to hydroxocobalamin, but the reverse action of this con-

version is not found as in pure solution. The results showed that some component in the digest is binding the cyanide ion. The vitamin in the aqueous extract of liver also behaved in the same way. This precluded the chances of peptides or amino acids as interfering substances. Further studies on the effect of metallic components of liver, sulfur compounds, etc., on the binding of this CN- group are in progress.

The talk was followed by a discussion where it was felt that it was very interesting to note that cyanocobalamin, which being very stable, otherwise, gets converted to hydroxo form so quickly in the liver digests and it was suggested that for the conformity of the data commercial sample should be taken as control. It may also be possible that the laboratory conditions are attributed to this change, therefore, experiments under strict controlled conditions may be carried out. It was further pointed out that sulphur molecule might bind the CN group and obstruct in its combination with the hydroxoform. It was felt that the problems like, effect of temperature tannins, Kinetics of different waves of light should be studied in detail.

The President, pointed out that while doing basic work, commercial products should also be taken into account, and liver being a storehouse of various metals, any of these may combine with CN group and can obstruct in its combination. The Institute work should be demonstrated to the Industry so that it may be benefited.

S (IS) 202 (149)

Studies on the Commercial parboiling and steaming treatment of paddy in rice mills, by H. S. R. Desikachar, (*March 30, 1957*). The speaker pointed out, at the outset, that although the rice parboiling industry is a major industry of the country, the organization and status of the industry were at a very low level. This was due to mainly the poor quality of the product, as produced and marketed by the industry. The main

defect is the undesirable fermented smell that arises in the parboiled rice as a result of prolonged soaking in cold water as also the high residual moisture content in the finished rice. The speaker pointed out that the fermentation during the soaking process, could be controlled either by adding a chemical to the water for soaking or by increasing its temperature, which besides controlling microflora will reduce the time of soaking to about 3-4 hours only. The application of this principle of 'hot soaking' to commercial production was then considered. In pilot plant trials in the laboratory with one ton batches of paddy, using a cylindrical kettle, as a soaking *cum* steaming tank, the design of the steam distributor, the optimum time and temperature of soaking etc., were first standardised.

The extension of these pilot plant trials to large scale commercial parboiling undertaken in a commercial rice mill in Mysore was then described. The results of these studies showed that the modified method of 'hot soaking' which consists of soaking the paddy in hot water at 70-80°C for 3-4 hours and then steaming the paddy in the same tank after discharging the soak water is a commercially feasible operation. The advantage of the suggested method, over the normal commercial practices now in vogue, were also described. The difficulties of hauling the hot paddy from the tank to the drying yard and the methods of overcoming them were also pointed out. The speaker pointed out that, on the whole, the suggested method is worthy of consideration by the rice miller for being used as routine commercial operation.

The problem of curing freshly harvested paddy for use, immediately after harvesting was then considered. After describing the basic data which had indicated that some type of 'wet heat' treatment to the paddy will reduce the pastiness of the rice during cooking and improve its culinary properties, experiments undertaken in the laboratory as well as in the rice

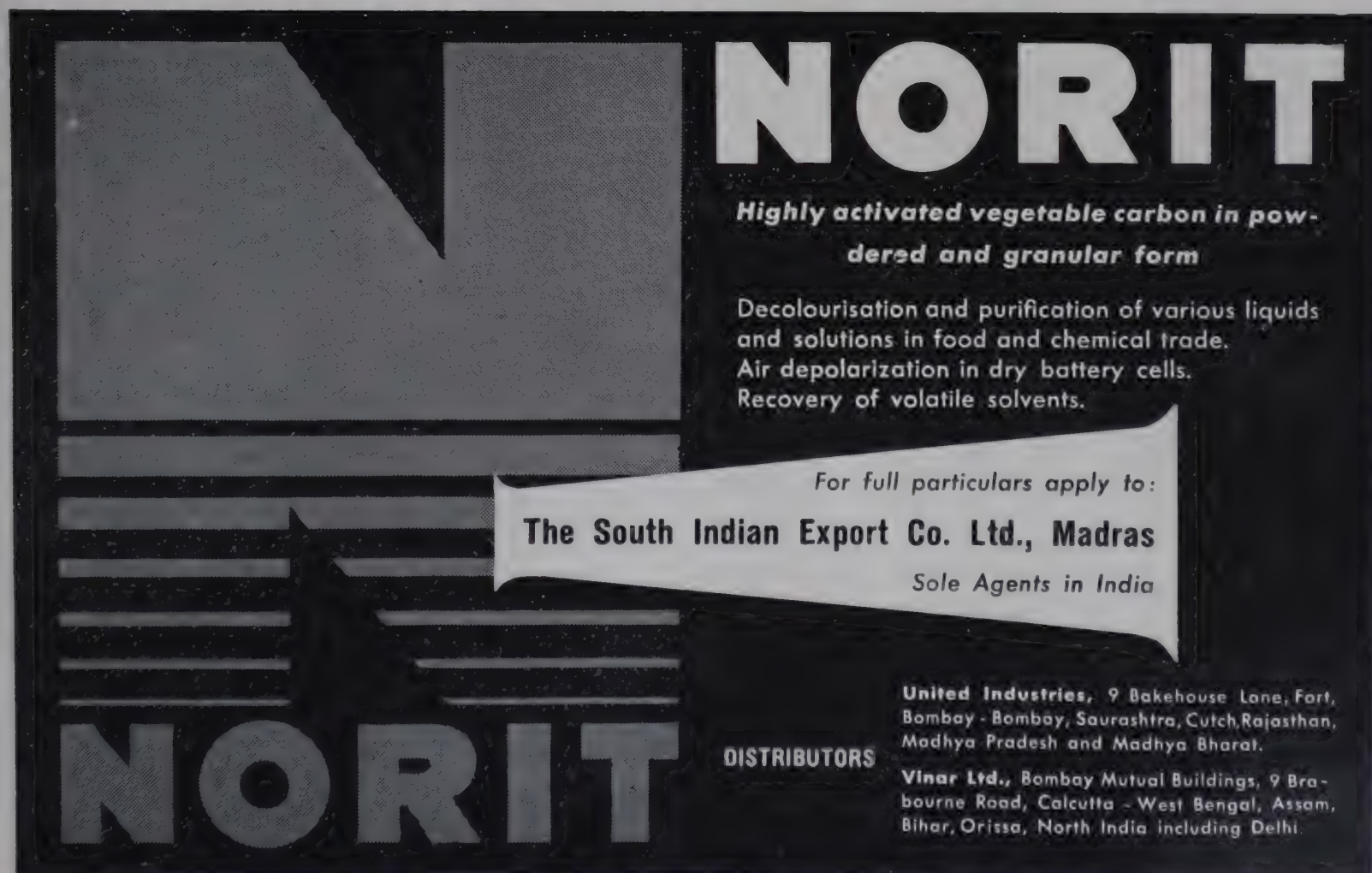
mills were described. A method that could be used in the house is to steam the soaked rice in a cooker and then continue the normal cooking. A type of simple rice cooker that could be used in the household was described. The method of choice, however, was to treat the paddy in the rice mill itself so that no special treatment during cooking of the rice in the home would be necessary. Large scale experiments of treatment of fresh paddy in a number of rice mills in Mysore were described. The procedure adopted for commercial curing was to steam the dry paddy for about 15-30 minutes, keep it in the hot condition for an hour, dry it by aeration in the shade or mild

sun and then mill it. Rice obtained from this treated paddy is opaque and looks like raw rice. It was pointed out that besides possessing the desired cooking qualities of old stored rice, this type of rice resembled parboiled rice or home-pounded rice in its thiamine content. The method is a simple one and can be used by all rice mills as a method of curing fresh paddy. As the cost of treatment was small (less than a rupee per palla of rice) the rice mills had evinced interest in the commercial treatment of the paddy.

The talk was followed by an interesting discussion and the important points that were raised related to the most suitable design

of steam distributor, over-heating due to scorching, moisture content in market samples of parboiled rice, storage quality of the treated fresh rice, cost of the steaming operations, design of the mechanical drying unit for drying paddy.

In his concluding remarks, the President pointed out that any new suggestion or modifications of existing procedures of parboiling could be such as to be acceptable to the industry. He pointed out that the design of a suitable mechanical drier should, however, be given due consideration. The need for extending the steaming treatment of fresh paddy to varieties belonging to the short duration group was also stressed by the President.



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Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Preparation of Lemon and Orange Essences

E (F) 19128 (351)

Please let me know the method of preparation of Lemon and Orange essences? (Kolhapur).

Lemon and orange essences are made from essential oils of lemon and oranges. The natural oil of fruits vary in their composition depending upon the maturity of the fruits. For preparation of essence, the natural oil is analysed and its deficient constituents made up, according to the secret formula of the manufacturer, by adding chemicals from outside. The standardised essential oil is used for making essences. There are two kinds of solvents used for the preparation of essences. They are (a) Alcohols like Ethyl or Isopropyl alcohol and (b) Non-alcoholic solvent like carbitol. Ethyl alcohol can be had from any distillery in India. Non-alcoholic solvent 'carbitol' is available from Messrs. A. Boake Roberts and Company (India) Ltd., 1-5, Seven Wells Street, St. Thomas Mount, Madras-16. Further, the maximum solubility of essential oil of orange and lemon in the above referred solvents is 5 per cent. In order to make strong essences, generally terpeneless essential oils are used. Terpeneless essential oils are made by fractional distillation of ordinary essential oils in which terpenes distil over first and are rejected. These oils are very expensive.

Preparation of Malt Vinegar

E (IS) 22188 (352)

Kindly furnish us the details of the method of preparation of Malt or brewed vinegar (Calcutta).

The malt or malt and barley are 'mashed' and soaked in successive quantities of hot water until the soluble content of the grain has been removed. The clear liquor or 'wort' is then cooled and transferred to another vat. Yeast is added, alcoholic fermentation taking place with the evolution of CO_2 . The wash is pumped over piles of beech twigs, shavings or wicker work placed in tall vats into which a regular supply of air is allowed to enter. The twigs are previously impregnated with a culture of *Mycoderma aceti*, which converts the alcohol into acetic acid. The pleasant taste and smell of malt vinegar is due to the small quantities of ethyl acetate and aldehyde formed during the process. A small quantity of alcohol, usually about 6 per cent remains in the finished product. This improves flavour and keeping quality. Storage for periods from 6 to 12 months, which allows the flavour to fully develop are quite common. Improvement in flavour is due to the formation of esters. Storage temperatures should preferably lie between 40 and 50° F. Malt vinegar is occasionally pasteurised at 145° F with a view to improving the keeping quality.

Standard: Malt vinegar is the product made by the alcoholic and subsequent acetous fermentations, without distillation, of an infusion of barley malt or cereals whose starch has been converted into malt. It contains not less than 4 g. of acetic acid per 100 c.c. (20° C.)

Preparation of Sugar Syrups

E (IS) 22188 ()

May I know whether syrups for squashes and cordials can be prepared by dissolving sugar in cold water

instead of boiling it? Does this have any effect on the keeping quality of finished product? (Calcutta)

Syrups used in the preparation of squashes and cordials can be prepared by dissolving the sugar in cold water. This will not have any effect on the keeping quality of the product. The amount of preservative is to be added according to the F.P.O. standards, a copy of which can be obtained from the Agricultural Marketing Adviser, Ministry of Food and Agriculture, 'P' Block, Raisina Road, New Delhi. It may, however, be more advisable to add a small quantity of citric acid to the syrup and boil the same in order to overcome the raw taste of sugar.

Preparation of Unsweetened Lime Juice Cordial

E (IS) 22188 (353)

Would you kindly indicate the method of preparing unsweetened lime juice cordial? Is there a need to add any extra preservative as against the sweetened type? (Calcutta)

Unsweetened lime juice cordial can be prepared by extracting the juice, diluting it with water, adding the preservative (potassium metabisulphite) at the prescribed level and bottling it in sterilised bottles. Addition of sugar is the only step to be deleted. There is no need to add any extra preservative except the one generally used in the preparation of the sweetened type. With regard to the marketing of such a product, you may look into the F.P.O. specifications.

Caramel from Sugar

E (IS) 22188 (354)

How is caramel obtained from sugar and are there any standards for such a product? Please inform

us whether we can use it for colouring vinegar in place of synthetic caramel powders. (Calcutta).

It would be perfectly alright if you use the real caramel for colouring vinegar. Caramel can be obtained by heating sucrose or glucose with small quantities of an alkali such as ammonia or its carbonate, sodium carbonate or caustic soda. The standards for such a product are as follows:

(i) *Extract*: 10 g. of the powder are dissolved in water, made up to 100 c.c., filtered and the specific gravity of the filtrate determined at 60°/60° F. The excess gravity (water 1000) multiplied by 2.24 gives the extract in brewers' pounds per 2 cwt. This figure is usually 63 to 68 lb. per 224 lb.

(ii) *Colour*: 10 c.c. of the above solution are diluted to 1000 c.c. and the colour read in a 1-in. cell (0.1 per cent soln.), using a Lovibond tintometer and glasses of 'Series 52'. Good brewers' caramels have a colour of 30-40 units.

(iii) The amount of iron that may be present in caramel should not exceed 0.03 per cent : . . calculated on the sample.

Substitute for Chicle gum

E (IS) 28795 (355)

Can you suggest some suitable substitute for chicle gum which is used in the manufacture of chewing gum? (Poona).

U.S.A. imports this gum chiefly from Belize in the British Honduras. Because of the cost of the chicle gum, many attempts have been made to find suitable substitutes but as yet no satisfactory substitute has been successfully found out to replace wholly chicle gum. However, some substitutes will compound very well with gum chicle and may be used as extenders. These are derived from the lowgrade rubber of Borneo known as 'pontianak' and inferior guttas such as gutta 'siak'. Waxes, resins and balsums may also be substituted for the gum chicle. A standard formula will be as follows: chicle 14 per cent,

chicle substitute 14 per cent, dextrose 14 per cent, caramel paste 1 per cent, powdered sugar 57 per cent, plus flavour as required.

Preparation of Synthetic Squash

E (F) 21993 (356)

Please give us the formula for the manufacture of synthetic orange and lemon squashes. (Jamalpur).

The manufacture of synthetic orange and lemon squash is not permitted under the F.P.O. The following formulae for synthetic orange and lemon syrups will be useful.

(a) Synthetic orange syrup

| | | |
|-------------------|-----|--|
| Sugar | ... | 70 lb. |
| Water | ... | 30 lb. |
| Citric Acid | ... | 1.5 lb. |
| Essence of orange | ... | 10 oz. |
| Benzoic acid | ... | 0.90 oz. or its equivalent sodium benzoate |
| Orange colour | ... | According to the shade desired. |

(b) Synthetic lemon syrup

| | | |
|------------------|-----|--|
| Sugar | ... | 70 lb. |
| Water | ... | 30 lb. |
| Citric acid | ... | 2.5 lb. |
| Essence of lemon | ... | 10 oz. |
| Benzoic acid | ... | 0.90 oz. or its equivalent sodium benzoate |
| Lemon colour | ... | According to the shade desired. |

Note: The acidity of the syrups can be adjusted according to the local taste by varying the quantity of citric acid.

Preparation of Apple Juice

E (F) 28583 (357)

What is the method of preparing unfermented apple juice? Kindly suggest the best varieties of the fruit suited for this. (Delhi).

Varieties: Yellow Newton and Baldwin apples grown in Kulu valley give good results.

Preparation: The apples are washed with dilute hydrochloric acid solution (5 gallons of acid in 100 gallons water) to remove arsenical and lead spray residues. They are then crushed in an apple grater to pieces of 1/8 to 1/2 inch size and from which the juice is

pressed in a basket press and collected in a non-corrodible vessel. The juice is then strained through coarse cloth to remove fruit tissues, etc., heated to 180-185° F, filled into clean bottles, closed and pasteurised for 30 minutes at 175° F.

Manufacture of Potato Starch

E (IS) 28794 (358)

How is starch manufactured from potatoes? Please furnish us the details of the process along with the cost of machinery and establishment. (Gaya).

The manufacture of starch from potatoes is comparatively a costlier process than from other common starch sources like corn, maize, wheat, etc. However, we are giving below, in brief, method for the manufacture of starch from potatoes:

Potatoes are washed free from dirt and mud in two washers arranged in series and provided with mechanical paddles. The washed potatoes are mashed and made into a pulp in a potato rasping machine like the Tahn saw tooth-rasp. The pulp is passed through rotary sieves to remove coarse particles which can be replaced. The fine pulp is flown into a tank where SO₂ is added at the rate of 1/2 lb. per ton of starch present in order to prevent decolorisation of the pulp and bacterial action. The pulp is centrifuged in a continuous imperforate, conical bowl centrifuge called the Uhland protein water separator. The solids are suspended in water and then passed over a series of fine sieves. The starch milk is now allowed to flow into a second Uhland protein-water separator. The solids are suspended in fresh water and then passed on to starch settling tables. The starch is flushed from the tables by jets of water at high pressure to a storage tank which feeds silk-shaker sieves of about 200 mesh. After passing through sieves, the starch is free from water in centrifuges. The starch cake is conveyed by spiral conveyer to a bucket elevator which feeds the drier. The dried

starch is pulverised in a hammer mill, bolted and packed.

For the detailed process of manufacture you may kindly refer to following books:

- (i) Chemistry and Industry of Starch, by Ralph, W. Kerr, published by Academic Press, Inc., 125 East 23rd St., New York 10, N.Y.
- (ii) Starch and its Derivatives, Vol. II, by J. A. Radley, published by Chapman and Hall Ltd., 37 Essex St., W.C. 2, London.

Regarding the cost of machinery and establishment, you may kindly contact some of the leading Engineering firms like:

- (a) Messrs Larsen and Toubro Ltd., Dougall Road, Ballard Estate, P.B. No. 278, Bombay-1.
- (b) Messrs Voltas Limited, 19, Graham Road, Ballard Estate, Bombay-1.
- (c) Messrs A. P. V. Engineering Co., Ltd., Post Box No. 2492, Calcutta.

Peanut Butter

E (IS) 28792 (359)

We would very much appreciate if you can supply us information

about the process and formula for the manufacture of peanut butter. Also advise us as to how it can be preserved and packed in cans. (Madras).

Best quality peanuts (ground-nuts) are selected. After decortication, the kernels are roasted carefully in an open pan or an oven with continuous stirring until they begin to brown. The temperature should not exceed 240° F when an oven is used. Care is necessary in roasting, for if it is carried too far, the butter will have a darker and burnt taste. If it is under-roasted it lacks flavour and colour and does not keep well. The roasted kernels are separated into halves by rubbing on a sieve. The skin and 'germs' or embryos are then removed. The presence of the germs is liable to cause the butter to go rancid sooner than it would otherwise do and the skins show up as red specks and give a slightly bitter taste. The white kernels are now made into a paste—neither too fine nor too coarse—in a grinder. Before grinding it is usual to add salt (1-3 per cent) and also sugar according to taste. To stabilise the peanut butter solid hydrogenated fats such as Dalda, Pakav, Marvo,

etc., are added to the paste upto 2 per cent, the amount depending upon the type of nuts, degree, solidity and the temperature. The mixture is then run through a homogeniser. The composition of peanut butter is as follows:

| | |
|-------------|----------------|
| Water | 2 per cent |
| Protein | 23-29 per cent |
| Fat | 36 per cent |
| Starch | 6 per cent |
| Sugar, etc. | 6 per cent |
| Fibre | 2 per cent |
| Salt | 1-3 per cent |

For preparation of peanut butter, Bauer No. 303 nut grinder is used. It is available from the Bauer Brothers Co., 1711, Sherdon Ave., Springfield, Ohio. The capacity of the grinder is 800 lb. per hour using 10 H.P.

There is no necessity of adding any chemical preservatives to the peanut butter. However, some antioxidants are added to stabilise the peanut butter. The butter can be kept in close jars in a cool, dry place for several months. If it is to be packed in cans, then sterilised metal resistant lacquered cans should be used.

BROCHURE ON HOME-SCALE FOOD PREPARATIONS SERIES

This brochure contains 66 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, viz., the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 55 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation; 'Indian Sweet Series' giving methods of preparation and preservation of 3 kinds of typical Indian sweets; and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products.

Price: Re 1-0-0 (postage extra)

Notes and News

STATISTICAL NOTES

*All India Final Estimate of
Groundnut, 1956-57*

| | 1956-57 Final Estimate | 1955-56 Partially Revised Estimate |
|--|---------------------------|--|
| Area (Thousand Acres) | 13,101 | 12,692 |
| Production (Thousand tons of nuts in shell) | 4,086 | 3,862 |

*(Economic and Statistical Adviser,
Ministry of Agriculture,
Government of India)*

*Export of Indian fruit and vegetable
products during November 1956**

| | Weight (lbs.) | Value (Rs.) |
|-------------------------------------|------------------|----------------|
| Canned fruits ... | 448 | 735 |
| Juices, Squashes, and Syrups ... | 6,708 | 10,804 |
| Mango and other chutneys ... | 1,83,601 | 1,46,096 |
| Mango slices and Brine ... | 1,01,600 | 31,816 |
| Pickles ... | 1,22,576 | 77,829 |
| Dry fruits ... | 5,600 | 5,544 |
| Dry vegetables ... | ... | 3,532 |
| Sauce ... | 112 | 268 |
| Guava Jelly ... | 56 | 264 |

* *Marketing Notes, November 1956,
issued by the Agricultural Marketing
Adviser to the Government of India,
New Delhi.*

C.F.T.R.I. NEWS

Visitors

The following distinguished persons visited the Institute during March 1957:

4-3-1957: Shri M. Govinda Reddy, Member of the Lok Shaba.

6-3-1957: Shri John Thivy, Indian Ambassador to Italy.

14-3-1957: Dr W. K. Velankar, Fisheries Research Officer, Mandapam.

16-3-1957: Dr B. Mukherji, Director, Central Drug Research Institute, Lucknow, Dr Hussain Zaheer, Director, Regional Research Laboratory, Hyderabad, Dr Goldman, Scientific Liaison Officer, Naval Research, American Embassy in London, Dr Beckers, St Xavier's College, Calcutta, and Mr N. R. Sathe of Messrs Sathe Biscuits and Chocolate Co., Ltd., Poona.

17-3-1957: Shri S. Nijalingappa, Chief Minister of Mysore and Shri P. M. Sundaram, Secretary, C.S.I.R., New Delhi.

19-3-1957: Shri S. S. Mehta, Technical Director, Tariff Commission, Bombay.

22-3-1957: Mr S. A. De Silva, Deputy Director, Irrigation Department, Colombo.

25-3-1957: Dr A. B. Bhansali, Chief Medical Officer, Standard Vacuum refineries, Ltd., Bombay; Mr Alexander Rogov and 19 Soviet Tourists from different parts of Russia.

26-3-1957: Mr G. K. A. John, Delegate, Darmstadt, Bombay.

Appointments and Postings

Senior Scientific Officers

Dr H. S. R. Desikachar
Mr N. V. R. Iyengar
Mr C. P. Natarajan
Mr G. S. Bains
Mr A. N. Sankaran

Junior Scientific Officers

Mr M. R. Chandrasekhara
Dr S. S. Kalbag
Dr H. C. Srivastava

Assistant Research Officer

Shri M. N. Satyanarayana

Research Assistant

Shri S. B. Kadkol

Nomination: Dr M. Srinivasan has been nominated as Principal representative on the Sectional Committee A.F.D.C. 11 of the Indian Standards Institution.

List of Papers Published

591. **Amino Acid Composition of Cashewnut Globulin**, by Subramanian, N., Lakshminarayana Rao, M.V. and Srinivasan, M., *J. sci. industr. Res.*, 1957, 16C (1), 24.

592. **Role of pH in the Canning of Jack Fruit (*Artocarpus integrifolia*)**. Effect of Adding Acid or other Fruits to the Canned Product, by Bhatia, B.S., Siddappa, G.S. and Lal, G., *J. Sci. Fd. Agric.*, 1956 (8), 531.

593. **Bulk Storage of Orange Squash Preserved with Sulphur Dioxide**, by Siddappa, G.S. and Bhatia, B.S., *Food Packer*, 1956, 10 (10), 11.

594. **Studies on the Nutritive Value of Balanced Malt Foods**, by Chandrasekhara, M.R., *et al.*, *Food Sci.*, 1957, 6 (1), 1.

595. **Stability of vitamin B₁₂ in Proteolysed Liver Extract**, by Sreenivasamurthy, V., Swaminathan, M. and Subrahmanyam, V., *Food Sci.*, 1957, 6 (1), 3.

596. **Chlorination Solves Corrosion and Odour Problems in Pasteurizers at Reduced Rates**, by John doe Magazine, *Food Sci.*, 1957, 6 (1), 4.

597. **The Nutritive Value of Low Fat Groundnut Flour**, by Subrahmanyam, V., Narayana Rao, M. and Swaminathan, M., *Food Sci.*, 1957, 6 (1), 5.

598. **Effect of Asafoetida on the Intestinal (Wall) Enzyme Systems in Vitro**, by Patwardhan, M.V. and Sastry, L.V.L., *Food Sci.*, 1957, 6 (2), 27.

599. **Nutritive Value of the Leaves of *Sauropus Androgynus*, (L) Merr. (*Chakur manis*)**, by Satyanarayana, M.N. and Rama Rao, G., *Food Sci.*, 1957, 6 (2), 29.

600. **Changes Effected by Insect Infestation in Groundnut Kernels**, by Kadkol, S.B., Pingale, S.V. and Swaminathan, M., *Food Sci.*, 1957, 6 (2), 30.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

Iodometric determination of iodate, bromate and dichromate in the presence of copper, by Satyanarayanamurthy, R.V.V. and Sastry, M.N., *J. sci. industr. Res.*, 1957, **16B** (2), 83—Iodate, bromate and dichromate can be determined iodometrically, in the presence of copper, using disodium salt of ethylene diamine tetra acetic acid (E. D. T. A.) as the complexing agent for copper. Copper can also be estimated simultaneously from a solution containing iodate and copper sulphate, but the method is not applicable for estimating copper in mixtures containing bromate or dichromate.

Studies on the potentiometric determination of ascorbic acid in fruit and vegetable extracts, by Sitaramiah, G., *J. Indian chem. Soc.*, 1957, **34** (2), 147—A potentiometric titration method with special Hg-Pt double electrode has been suggested by Harris and co-workers for the determination of ascorbic acid in highly pigmented and turbid solutions, but the electrode does not serve well in concentrated extracts. The author has therefore, tried to evolve a satisfactory potentiometric procedure for the determination of ascorbic acid in fruit and vegetable extracts. The reference electrode used was a saturated calomel electrode with a KCl-agar salt bridge and the titrations were carried out in CO₂ atmosphere. Gold-coated, Hg-coated and Ag-coated, Pt-electrodes as well as bright and platinised Pt. electrodes were tried to select the best suited one for the accurate determination. The results show that a rod-type Pt electrode with a thin layer of Hg. appears to be a satisfactory electrode for the ascorbic acid determination in fruit and

vegetable extracts. Gold coated Pt-electrode can also be used as it also gives good results.

K.L.R.

Reversed-phase chromatography: Part I—Identification of fat-soluble dyes, by Verma, M.R. and Ramji Dass, *J. sci. industr. Res.*, 1957, **16B** (3), 131.—A method has been developed for the identification of fat-soluble dyes by paper chromatography. The paper used for elution of fat-soluble dyes is prepared by impregnation with paraffin liquid, *n*-lauryl alcohol, oleic acid or diethulene glycol monostearate. The elution is carried out with aqueous solutions of acetone, methyl alcohol, dioxane and ethylene glycol.

BIOCHEMISTRY AND NUTRITION

The enzymes of fearl millet (*Penisetum typhoideum*) malt: Part I—amylases, by Chandrasekhara, M.R. and Swaminathan, M., *J. sci. industr. Res.*, 1957, **16C** (2), 35,—Pearl millet (*Penisetum typhoideum*) in the ungerminated condition contained negligible amylase activity. Germination of the grain led to a marked increase in the α -amylase activity, but only a slight increase in the β -amylase activity. The diastatic activity of the pearl millet malt was found to be less than that reported in the literature for the malts of barley, wheat and ragi. The optimum pH for the activity of both α - and β -amylases was 4.8 and the optimum temperature 60°C. The critical inactivation temperature for the α -amylase at pH 4.8 was 45°C.

Metabolism of d-tryptophan and l-kynurenine in corcyra cephalonica St., by Sundaram, T.K. and Sarma, P.S., *J. sci. industr. Res.*, 1957, **16C** (3), 48.—

The metabolites of d-tryptophan excreted by the normal and vitamin B₆-deficient *Corcyra* larvae and the distribution of d-amino acid oxidase in the normal larval tissues have been studied. It has been found that this insect is not capable of utilizing for metabolic purposes the d-isomer of the amino acid in place of the l-form. The metabolism of l-kynurenine in normal and vitamin B₆ l-deficient larvae has also been investigated and the results support the concept of the tryptophan \rightarrow nicotinic acid conversion occurring the in insect.

Physico-chemical studies on indigenous seed proteins: Part II—fractionation, isolation and electrophoretic characterization of sesame globulins, by Ravindra Nath and Giri, K.V., *J. sci. industr. Res.*, 1957, **16C** (3), 51—Fractionation of sesame seed proteins has been carried out by (1) extraction with different solvents, (2) coagulation by heating at different temperatures, (3) fractional precipitation with ammonium sulphate, (4) dialysis against sodium chloride solutions of different concentrations and (5) dilution and fractional precipitation with ammonium sulphate, and the various fractions tested for their homogeneity electrophoretically. No homogeneous fraction could be isolated by ammonium sulphate fractionation. Dialysis against sodium chloride solutions gave a fraction which was electrophoretically homogeneous but there was considerable loss of protein. The dilution and fractional precipitation method gave the best results and four fractions were isolated. The first, which was the major fraction (65-70 per cent) with an iso-electric point of 4.65, was electrophoretically homogeneous between pH 3.0 and 12.0.

This fraction has been identified as the globulin described by Jones *et al.*

Vitamin B₁₂ and the alkali-stable vitamin B₁₂-like factors in palm Gur, by Joshi, M.R. and Kamala Sohoni, *J. sci. industr. Res.*, 1957, **16C** (3), 68.—Factors possessing vitamin B₁₂-like activity present in palm gur have been characterized employing *Escherichia coli*, *Lactobacillus leichmannii* and *Escherichia gracilis* as the test organisms.

The role of pantothenic acid in the biosynthesis of ascorbic acid in the rat, by Thangamani, A. and Sarma, P.S., *Curr. Sci.*, 1957, **26** (3), 72.—Earlier work has shown that glucose cyclo-acetoacetate helps in an increased synthesis of ascorbic acid in germinating mung beans and also in rats and that thiamine and pantothenic acid are required for converting glucose cyclo-acetoacetate to ascorbic acid in germinating greengram. In the present study, the AA have investigated the role of pantothenic acid in the conversion of the precursors, glucose cyclo-acetoacetate and glucuronic acid to ascorbic acid in the rat. Pantothenic acid deficiency was produced in weanling albino rats and then were given intra-peritoneal injection of glucose cyclo-acetoacetate or d-glucuronolactone. Excretion of ascorbic acid in the urine of pantothenic acid deficient rats and the control group was estimated before and after giving the injections. Glucose cyclo-acetoacetate was also determined with a view to find out whether this compound accumulated in case of vitamin deficiency using a highly sensitive spectrophotometric method. The results show that the normal excretion of ascorbic acid is considerably reduced in pantothenic acid deficient rats while in the control group, it increased after an injection of glucose cyclo-acetoacetate. The excretion increased in both the groups, when d-glucuronolactone was injected. Thus, the presence of pantothenic acid is very essential only for the conversion of the acetoacetate to ascorbic

acid and not the conversion of d-glucuronic acid to ascorbic acid. It has also been found that more of unmetabolised glucose cyclo-acetoacetate is excreted by deficient rats than by the control group indicating the need for pantothenic acid in the metabolism of the acetoacetate. However, most of the injected compound is metabolised in the body of rats of both the groups.

K.L.R.

Arginine content of some oilseed cakes, by Ramachandran, B.V., *J. sci. industr. Res.*, 1957, **16** (3), 70.—Oilseed cakes are a potential raw material for the large scale preparation of some commercially important amino acids. In this note, the author reports the arginine content of some of indigenous oilseed cakes viz., groundnut, *til*, castor, linseed, mustard, safflower and *mowra* cakes. The values have been determined by the calorimetric method of Macpherson and also by the gravimetric method of Vickery using flavinic acid as the precipitant. The results show that groundnut and *til* cakes are rich in arginine.

COFFEE

Studies on tannin-like constituents in coffee, by Natarajan, C.P., Iyengar, J.R., and Bhatia, D.S., *J. sci. industr. Res.*, 1957, **16C** (2), 42.—The chlorogenic acid content of Indian Coffee (*Arabica* and *Robusta* varieties) has been determined. A method based on lead acetate precipitation and titration with permanganate has been found satisfactory for the determination of polyphenolic constituents in coffee. The effects of roasting and storage on the polyphenolic constituents in coffee have been studied.

FISH

Protein hydrolysate from fish, by Velankar, N.K., *J. sci. industr. Res.*, 1957, **16A** (3), 141.—Fermented liquid preparations from fish, though uncommon in India, are commonly used in the South East Asian countries. The *maggi*

sauce used in Europe is similar in preparation and properties to the *nam-pla* of Thailand, *patis* of the Philippines and the *nuoc-mam* of the Indo-China. *Nam-pla* has been shown by analysis to be essentially, a protein hydrolysate. The author has prepared a very similar product using sardines (mainly *Sardinella dayi* Regan). The process employed has been described in this note. The product has no fishy or unpleasant odour and indistinguishable from Thailand *nam-pla* in appearance. It keeps well at room temperature for several months. The possibility of applying this method for the manufacture of fish sauce on a cottage industry scale is being worked out by the author.

K.L.R.

MICROBIOLOGY

Studies on Indian soil micro-organisms: Part III. Antibiotic production by actinomycetes isolated from Indian soils, by Dhala, S.A. and Bhatnagar, S.S., *J. sci. industr. Res.*, 1957, **16C** (2), 30.—One hundred and fifty-three strains of actinomycetes isolated at random from soils from 24 locations in India were screened for their antibiotic activity. Of these 75 (49.02 per cent) showed antagonistic action against at least 1 to the 8 test organisms consisting of 3 Gram-positive, 1 acid-fast and 4 Gram-negative bacteria. The degree of activity ranged from slight to strong, with the number of test organisms inhibited by any single culture varying from 1 to 8. The results suggest that actinomycete producing antibiotics are widely distributed in Indian soils.

Synthesis of riboflavin by *Ermothecium ashbyii*, by Lulla, B.S. and Johar, D.S., *J. sci. industr. Res.*, 1957, **16C** (2), 45.—Riboflavin production by *E. ashbyii* employing wheat and rice bran, malted barley and *ragi*, oilseed cakes, tapioca and potato flour and lucerne meal as substrates has been investigated. Wheat and rice brans have been found to be the best substrates for the production of the vitamin by the organism. A method for the

preparation of a riboflavin concentrate employing wheat bran as substrate is described.

Three undescribed fungi from Bombay, by Chiddarwar, P.P., *Sci. & Cult.*, 1957, **23**, 511.—The A. reports in this note three new species of fungi hitherto unknown viz., *Pseudocercospora gomphrenicola* nov., *Pseudocercospora daturai* sp. nov. and *Arthrobotryum glochidii* (Petch) var. *lanceolaris* var. nov. These have been isolated from the vicinity of Poona and Mahableshwar. The description and characteristics of these new fungi are given in Latin.

K.L.R.

OILS AND FATS

Calophyllum inophyllum Linn Part I. Chemical constituents of nut oil and the stem bark, by Mitra Chittaranjan, *J. sci. industr. Res.*, 1957, **16B** (3), 120.—A lactone, calophyllolide, a related acid, calophyllic acid, a new polyene acid, inophyllic acid, and an essential oil fraction have been isolated from the non-glyceridic portion of the oil obtained from the nuts of *C. inophyllum* Linn. Inophyllic acid has also been found to be present in the stem bark of the plant.

GENERAL

Alginic acid from sargassum seaweeds, by Krishna Pillai, V., *Res. & Ind.*, 1957, **2** (3), 70.—Alginic acid is mainly used as a stabiliser in food industries. A simple method, easily adoptable on a cottage industry scale for the preparation of pure alginic acid and alginates from *sargassum* seaweeds has been described. Three species of the seaweeds which are available in large quantities along the Indian coast have been tried. The dry seaweeds are treated with permanganate before extraction, so that partial deodorisation of algae is effected. The algae is then digested with 2 per cent soda ash for 1-2 hours and alginic acid is precipitated from the crude extract by adding requisite amount of hydrochloric acid. The crude precipitate is bleached with small quantities of potassium permanga-

nate in presence of hydrochloric acid. The precipitate is then washed free of acid. A flowsheet of the process is given. The main advantage of this method is that the use of the unstable hypochlorite for decolourising the algin is replaced by potassium permanganate.

K.L.R.

Aca-catechin—A new anti-oxidant: Part II, by Husaini, S.M., Radhavendra Rao, S. and Saletore, S.A., *J. sci. industr. Res.*, 1957, **16A** (3), 128—Aca-catechin, a constituent of catechu (katha), has been shown to be a good anti-oxidant for fats and oils in spite of its low solubility in them. Addition of 0.05 and 0.1 per cent aca-catechin to ghee increases its shelf storage life from 123 to 240 and 210 days respectively. Its carry-through properties in potato chips and biscuits are promising.

Studies on groundnut shells: Part I. Proximate analysis and the sugar make-up of the hemicellulose fractions, by Radhakrishnamurthy, B and Srinivasan, V.R., *J. sci. industr. Res.*, 1957, **16C** (3), 59.—The major constituents of groundnut shells are non-cellulosic in nature. The hemicellulosic part of the shells has been fractionated into six fractions and their sugar make-up has been determined. Xylose, arabinose and uronic acid are common to all the fractions; three fractions contained, in addition, rhamnose, and two others both rhamnose and galactose.

Chemical studies on Indian seaweeds, by Krishna Pillai, V., *Pro. Ind. Acad. Sci.*, 1957, **KLV** (2), 43.—An attempt has been made to study the chemical partition of nitrogen in eleven species of seaweeds belonging to the three major groups, Chlorophyceae, Rhodophyceae and Phaeophyceae. The seasonal variation in the total organic, water-soluble, volatile, protein and non-protein nitrogen contents were followed by analysing regular monthly collections of the algae. The importance of each of the fraction in the metabolism of

the algae has been discussed. It is observed that the seaweeds are poor in their total nitrogen content, the values never exceeding 2 per cent on the dry basis. In species like *G. lichenoides* the total nitrogen content shows an inverse ratio to that of the agar content. Protein nitrogen is less in young plants, while in the mature plants it accounts for more than 75 per cent of the total organic nitrogen. Water-soluble and volatile nitrogen content also follows the total nitrogen giving maximum values in September-December and minimum in July. The amino acid composition of two sets of collections representing two distinct growth stages has also been studied quantitatively. It is observed that although the protein-nitrogen content varies substantially between the young and the mature plants the amino acid composition remains almost identical. The chromatographic method employed in the quantitative estimation of the amino acids has been outlined.

Chemical studies on Indian seaweeds III. Partition of sulphur and its relation to the carbohydrate content, by Krishna Pillai, V., *Proc. Ind. Acad. Sci.*, 1957, **KLV** (3), 101.—Detailed investigations have been conducted on the partition of sulphur in different seaweeds common to the Indian coast. Among the seaweeds studied are two Chlorophyceae, seven Rhodophyceae and two Phaeophyceae. The amount of total sulphur, total sulphate and free sulphate in the different seaweeds were estimated periodically by analysing regular monthly collections. From this study it was also possible to follow the changes in the sulphur content of the algae during the different stages of its growth and during different seasons. An attempt has also been made to bring out possible correlation between the different forms of sulphur and the carbohydrate content of the algae. It is observed that in the young plants most of the sulphur is present in the ionic form and that

there is practically very little difference between the free sulphate and the total sulphate. As the algae grow the difference between these two sulphate fractions increases steadily, except perhaps in the brown species, indicating that more and more sulphate passes from the free state into a state of combination with the organic compounds. It is also seen that the variation in the fraction of sulphate which is extracted only in hot water is directly proportional to the variations in the agar content of the

seaweeds. In the two species of Chlorophyceae examined most of the sulphur exists in the free sulphate form throughout the year. Phaeophyceae contain only comparatively low amounts of sulphur and that practically no difference is noticed between the ionic sulphate and total sulphate. The studies in the variations in the sugar content in the different fractions of the seaweed bring forth several interesting results. The total sugar content in the hydrolysate of the individual algae shows

a general maximum during the months April-June when the organic constituents are found to be maximum. Young specimens of almost all the seaweeds show varying amounts of simple reducing sugars in their cold water-soluble portions, indicating probably that the first products of photosynthesis in growing seaweed are the simple sugars. As the algae grow these simple sugars are converted to higher forms and in the mature algae they are present only in very minute quantities.

PART II (Foreign)

ANALYTICAL

The quantitative determination of amino acids by paper chromatography. A solvent to replace phenol, by Wolfe, M., *Biochim. Biophys. Acta*, 1957, **23** (1), 186.—A one-phase solvent consisting of *n*-butanol, methyl ethyl ketone, 17N ammonia and water (5:3:1:1, v/v) has been used instead of phenol in two dimensional paper chromatography for which *n*-butanol acetic acid-water (4:1:5, v/v) is used as the solvent. Clear separations, allowing quantitative recoveries, of the amino acid constituents of proteins have been obtained. Losses of amino acids during chromatography and subsequent estimations by a ninhydrin colorimetric procedure are small being mainly from 1-4 per cent.

The *RF* values of 25 naturally occurring amino acids are given for this aqueous butanol-ketone-ammonia solvent.

Analysis of mixtures of higher saturated normal fatty acids: A comparison of reversed-phase partition chromatography and ester fractionation, by Garton, G.A. and Lough, A.K., *Biochim. Biophys. Acta*, 1957, **23** (1), 192.—The reversed-phase partition chromatographic method of HOWARD AND MARTIN for higher fatty acid analysis has been extended to include the odd-numbered *n*-fatty acids C₉-C₁₉. The method was applied to the analysis of the saturated, non-volatile fatty acids

from four samples of bovine milk fat and the results compared with the analyses obtained by the ester-fractionation procedure; good agreement between the two methods was found. No odd-numbered *n*-fatty acids were detected chromatographically in the whole group of mixed saturated fatty acids though traces of tri-decanoic acid were detected when the fatty acids from individual ester fractions were analysed chromatographically.

Polarographic determination of tin in foods, by Markland, J. and Shenton, F.C., *Analyst*, 1957, **82** (970), 43.—A polarographic method has been developed for the routine determination of tin in canned foods. Recovery experiments indicated that with 1-mg quantities of tin the accuracy was about ± 3 per cent. Interference due to residual nitric acid has been avoided by heating the acid digest with ammonium oxalate.

A rapid photometric procedure for the determination of thiamine with 6-aminothymol, by Hayden, K.J., *Analyst*, 1957, **82** (970), 62.—A simple and rapid procedure is described for the determination of thiamine in certain pharmaceutical and cereal products; it depends on the intense yellow colour produced on treatment of the vitamin with diazotised 6-aminothymol. The solubility of the colour in alkaline media, together with lower sensitivity to interfering substances and precise experimental

conditions, renders this reagent more suitable for routine work than *p*-amino-acetophenone. The method is applicable to materials containing upwards of 0.1 mg. thiamine per g and the maximum experimental error of a single determination is 1.5 per cent.

BIOCHEMISTRY AND NUTRITION

ATPase activity of rat liver mitochondria, by Klemperer, H.G. *Biochim. Biophys. Acta*, 1957, **23** (2), 404.—ATPase and oxidative phosphorylation were studied in rat liver mitochondria prepared in a medium consisting chiefly of 0.9 per cent KCL. The aerobic rate of ATP hydrolysis was calculated from the rate of ³²P incorporation into ATP under steady state conditions of oxidative phosphorylation. This was compared with the rate of net ATP breakdown under various conditions.

In the presence of succinate the anaerobic net ATP breakdown rate was 30 per cent less than the aerobic hydrolysis rate as calculated from the rate of incorporation of ³²P into ATP.

The net ATP breakdown rate in presence of 10⁻⁴ M DNP was 30 per cent greater than the rate of ATP hydrolysis as calculated from the rate of ³²P incorporation under steady state conditions in the absence of DNP. However, the latter was the same as the rate of net ATP breakdown in the presence

of $5 \cdot 10^{-5}$ M DNP, which shows that at this concentration DNP uncouples without activating ATPase.

The action of 10^{-4} M L-thyroxine resembled that of 10^{-4} M DNP, but the rate of net ATP breakdown in presence of $3 \cdot 10^{-4}$ M L-thyroxine was less than the rate of ATP hydrolysis under steady state conditions.

DNP increased the rate of net ATP breakdown by aged mitochondria, but L-thyroxine had no effect. Unlike DNP, both ageing and L-thyroxine caused swelling of the mitochondria. DNP and L-thyroxine therefore seem to activate ATPase in different ways.

Preparation and amino acid composition of enzymically dephosphorylated casein, by Sundararajan, T.A. and Sarma, P.S., *Biochem. J.* 1957, 65 (2), 261.—The preparation from ox spleen of a phospho-protein phosphatase free from proteolytic activity and suitable as a dephosphorylating agent for casein is described.

The preparation and some properties of dephosphorylated casein are described. In preparation of the protein, advantage has been taken of the insolubility of the dephosphorylated casein at pH 6.0, which is also the optimum pH for the enzymic dephosphorylation.

Acid-soluble nitrogen formed during the enzymic dephosphorylation of casein has been determined and the nature of the nitrogenous product investigated by paper chromatography.

Dephosphorylated casein has been analysed for amino acids. Comparison of the values with those obtained for casein shows that the amino acid composition of casein and of its dephosphorylated product are about the same.

It is concluded from these studies that during the enzymic dephosphorylation of casein the protein remains relatively intact and that the changes, if any, brought by this treatment are not of a drastic nature. The relative merits of alkali and enzymic dephosphorylation methods are discussed.

Biosynthesis of fatty acids in cellfree preparations. 4. Synthesis of fatty acids from acetate by a partially purified enzyme system from rabbit mammary gland. Hele, P., Popjak, G. and Lauryssens, M., *Biochem. J.*, 1957, 65 (2), 348.—A partially purified enzyme preparation has been obtained from lactating rabbit mammary gland that catalyses the synthesis of even-numbered-chain fatty acids from C_4 to C_{18} , with the shorter-chain fatty acids preponderating.

This synthesis is achieved from acetate, coenzyme A (CoA), adenosine triphosphate and stoichiometric amounts of reduced diphosphopyridine nucleotide (DPNH). The intermediates involved have been studied by paper chromatography, as their hydroxamates. The finding strongly suggest that fatty acid synthesis in these enzyme preparations takes place by a stepwise condensation of C_2 units through the reversal of the now well-established betaoxidation of even-numbered-chain fatty acids.

TPNH and lipoic acid in our system have no stimulatory effect upon the synthesis of even-numbered-chain fatty acids by the mechanism outlined above.

DPNH appears to act as a specific electron donor for both the reduction of beta-ketoacyl-CoA to beta-hydroxyacyl-CoA and of unsaturated fatty acyl-CoA to saturated fatty acyl-CoA. This latter reduction step appears to be stimulated in some manner, as yet undefined, by metabolic derivative of adenosine 5-phosphate, which is not hypoxanthine and which may possibly be inosine monophosphate.

A diet restricted in refined cereals and saturated fats, by Van Handel, E., Newmann, H. and Bloem, th., *Lancet*, 1957, No. 6962, 245.—The study was undertaken to evaluate the effect of a regimen low in saturated fatty acids and degerminated carbohydrates on patients with clinical atherosclerosis. The diet consisted of whole wheat bread, liquid soya-bean oil as cooking fat, lean meat, milk, cheese and eggs, with margarine

and butter restricted to 25 g. per day. Lard and other animal fats, shortening, white bread and foods made from degerminated flour and cereals were not allowed. In addition, 2-3 g. of soya lecithin, 25-50 g. of peanuts, 25-50 g. of peas or beans, 25-50 g. of 'Nurupan' (whole soya flour) were included as obligatory daily supplement. The results showed that there was a steady drop in the serum cholesterol when the initial values were high. The patients also showed noteworthy improvement of disposition and ability to perform normal activities.

Effects of caloric intake on nitrogen balance and organ composition of adult rats, by Rosenthal, H.L. and Allison, J.B., *J. Agric. Chem.*, 1956, 4, 792.—It was demonstrated that rats may be maintained in positive nitrogen balance when subjected to a dietary caloric deficiency. The animals did not remain static on restricted diets but adopted through shifts in metabolism, possibly to maintain essential tissues in a steady state commensurate with the quantity and quality of dietary nutrients.

M.N.R.

Acceptability of irradiated foods, by McGary, V.E. and Shipman, M.E., *J. Amer. diet. Ass.*, 1956, 32, 1059.—Irradiated foods have been fed to human beings in three balance studies. Many irradiated food items were as acceptable as the non-irradiated control food items. Statistical analysis of the acceptability data showed significant differences between irradiated and control food in only nine out of thirty-six items.

M.N.R.

Utilization of ascorbic acid in fruits and vegetables, by Davey, B.L., et al., *J. Amer. diet. Ass.* 1956, 32, 1064.—The reduced, dehydro and total ascorbic acid value of twenty-four selected fruits and vegetables are presented. The ascorbic acid from the twenty-four foods was found to be utilized as well as the synthetic ascorbic acid as judged by total ascorbic acid in

blood plasma and total and reduced ascorbic acid in urine.

M.N.R.

Cereal storage effects, storage changes in parboiled rice, by Houston, D.F., Hunter, I.R. and Kester, E.B., *J. Agric. Fd. Chem.*, 1956, 4 (11), 964.—Colour changes during storage of two varieties of parboiled rice were shown to be negligible for about one year at room temperature (25°C) in either open or sealed containers. At 100°F (37.8°C) and 140°F (60°C), the changes appeared after 3 to 4 months. The original destruction of enzymes by parboiling, the storage losses of reducing sugars and amino nitrogen, the increase in browning rate with increased moisture or temperature, the lack of oxygen requirement during storage changes, and the marked inhibition of colour by SO₂ confirmed that the browning is of the Millard type. SO₂ added to the rice during parboiling inhibited browning, and gradually disappeared during storage, but did not delay rancidification. Varietal and process effects were evaluated by accelerated storage tests at 60°C. It has been concluded, from the results obtained, that the maximum shelf-life of parboiled rice is dependent not on variety but on processing conditions. Hence it would be possible to modify the keeping quality and the appearance of the commercial product by varying the manufacturing process.

G.V.K.

FISH

The amino acid composition of fish collagen and gelatin, by Eastoe, J.E., *Biochem. J.*, 1957, 65 (2), 363.—The amino acid compositions of collagens and derived gelatins from sturgeon, cod, the shark (*Selachus maximus*) and the Australian lung fish have been determined.

These fish collagens show a similar amino acid distribution to mammalian collagen, with decreased amounts of proline and hydroxyproline, and increased serine, threonine and, in some cases, methionine and hydroxylysine.

Gelatin prepared from cod bone has a very low rigidity at 10°, whereas sturgeon, shark and lungfish collagens give rise to gelatins having rigidities of the same order as, but probably somewhat below, those of mammalian gelatins.

In general, the shrinkage temperature of the collagen and gel properties of extracted gelatin decrease with decreasing hydroxyproline content. Certain departures in detail from this behaviour indicate that other unknown features of composition may influence the stability of linkages between polypeptide chains.

Variations in the properties and composition of fish collagens seem to be related to the water temperature of the normal habitat, rather than to considerations of broad zoological classification.

FRUIT AND VEGETABLE PRODUCTS

Fruit juice constituents, composition of commercial, segment and peel juices of florida Oranges, by James, L. and Veldhuis, M.K., *J. Agric. Fd. Chem.*, 1957, 5 (1), 48.—In recent years, it has been observed that the yield of juice from oranges has increased to a great extent. This was due to more efficient extraction in which substantial amounts of peel and rag extractives have also been incorporated. Comparative composition studies were conducted with commercially extracted orange juice, hand pressed segment juice and peel juice throughout a season. Peel juices were always highest in pH, soluble solids, Brix-acid ratio, soluble pectic substances, ascorbic acid, flavonoids, diacetyl, and colour and lowest in acidity. Peel juice were usually highest in specific gravity and viscosity. During the early part of the season, sucrose was lowest and reducing sugars were highest in peel juices. The pH remained constant for peel juice whereas there was a slight increase in other juices. The segment and commercial juices showed no change in insoluble pectic substances throughout the season; but the peel juice,

showed marked upturn late in the season. Ascorbic acid progressively decreased as the season advanced. The flavonoid content of segment and commercial juices were remarkably constant throughout the season; but in peel juices it was very high and progressively decreasing with the season. Peel juices added at a level of 3 per cent in the reconstituted concentrate were detected with significance by a taste panel.

G.V.K.

Citrus and pineapple juices—Influence of raw materials on quality, by Kefford, J.F., *Austr. Fd. Manuf.*, 1957, 26 (7), 36.—Quality and chemical composition in citrus juices are largely determined by the nature of raw materials from which the juices are prepared. The author gives an account of varietal differences, rootstocks on which fruit are grown, stage of maturity, manures and pesticidal sprays, and climatic differences being the main factors that determine the quality of the juice. Low N₂ supply to the tree tend to produce high acidity and high ascorbic acid whereas excess phosphates decrease soluble solids and acidity. Copper sprays increase and lead arsenate sprays decrease the acidity of the grape fruit. Fruits which are exposed to direct sun light have more solids and ascorbic acid than shaded fruits.

The quality of the pineapple juice differs not only by the varietal difference but also from different parts of the same fruit. Thus juices from cores are lower in sugars, acids and volatile flavours than the juice from fleshy tissues. The Brix of the juice from the bottom quarter is highest and gradually decrease towards the top and reaches the minimum at the top quarter. High temperatures favour high sugar content, low acidity and high content of volatile flavours. Ascorbic acid content is higher in winter crops than in summer crops. In summer fruit, the esters are largely ethyl esters, whereas in winter they are almost entirely methyl esters. High levels of N₂ and K produce high acidities.

G.V.K.

Organoleptic evaluation of apple sauce fortified with essence and citric acid, by Buch, M.L., Dryden, E.C., Hills, C.H., and Oyler, J.R., *Food Tech.*, 1956, **10** (11), 560.—Apple sauce was improved by the addition of apple essence. The essence from peels and cores was quite satisfactory. There was only a slight loss of flavour during ten months' storage at room temperature of 70°F. Addition of 0.1 per cent citric acid imparted a pleasant tartness to the sauce, but 0.2 per cent of it made the sauce rather too tart for most tasters. Approximately 1.5-fold added essence was required to show any significant improvement.

G.S.S.

Stability of frozen concentrated orange juice: II. A comparison of several methods of heat stabilizing frozen orange concentrate, by Guyer, R.B., Miller, W.M., Bissett, O.W. and Veldhuis, M.K., *Food Tech.*, 1956, **10** (11), 570.—Commercial methods of stabilization of frozen orange juice concentrate, currently used include direct steam injection, various plate type heat exchangers and large tube pasteurizers. These commercial units appear to have characteristics which differ from the experimental units. Direct steam injection method provided stability as good as, and in most cases, better than the small tube, turbulent flow method. With the exception of the 150°F variable the per cent of pectinesterase activity remaining in the 42° Brix concentrate made from heat-stabilized juice was approximately the same, regardless of the methods used. As the treatment temperature increased from 150°F to 180°F, the degree of increased effectiveness of direct steam injection over the small tube method became more pronounced. A commercial plate type heat exchanger gave a somewhat better cloud stability than a small tube heat exchanger. The mechanism of cloud retention or loss is, however, not yet fully understood

G.S.S.

Storage stability of canned concentrated tomato juice, by McColloch, R.J., Rice, R.C. and Underwood, J.C., *Food Tech.*, 1956, **10** (11), 568.—Tomato juice concentrates of approximately 21 per cent soluble solids content concentrated at low evaporation temperatures, less than 150°F, possess characteristics of colour and ascorbic acid stability which are not greatly different from those of single strength tomato juice. At the end of storage for 6 months at 100°F, the flavour of tomato juice concentrate evaporated at 150° and at 200°F was highly significantly different from that of the control.

G.S.S.

Growth characteristics of spoilage organisms in orange juice and concentrate, by Berry, J.M., Witter, L.D. and Folinazzo, J.F., *Food Tech.*, 1956, **10** (11), 553.—Growth curve characteristics in orange juice and concentrate of the three different types of organisms, namely, *Leuconostoc* sp., *Lactobacillus plants rum*, Var. *mobilis* and *Zygosaccharomyces* when grown at 86°F, 60°F, 50°F, and 40°F have been studied.

The lag phase of microorganismal growth was independent of the growth conditions and was a function of only the nature of the inoculating culture.

At temperatures below the optimal temperature of 86°F, there was a decrease in the growth rate of the three organisms.

An increase in the Brix from the optimum of 12° and 20° resulted in their growth rate.

Both the *Leuconostoc* and the *Lactobacillus* strains tested did not grow at 40°F regardless of the degree of Brix and did not grow at 42° Brix, regardless of the temperature. At 40°F, the yeast grew slowly in all concentrations through 42°B.

INSECTICIDES

The fate of aldrin and dieldrin in the animal body, by Bann J.M., DeCino, T.J., Earele, N.W. and Yun-Pei Sun, *J. Agric. Fd. Chem.*, 1956, **4** (11), 937.—With

the widespread use of aldrin and dieldrin, information concerning their fate in the animal body is of considerable interest. Recent studies indicate that the conversion of aldrin to dieldrin takes place readily in the animal body and is fairly complete. It is assumed to occur in all animals inasmuch as it has been demonstrated in beef and dairy cattle, pigs, sheep, rats, and poultry. The change is apparently independent of the site of entry of the toxicant, as it occurs following either oral ingestion or subcutaneous injection. Dieldrin apparently is chemically unchanged in the body and is stored as such. The data include comparative analyses by colorimetric, bioassay, total organic chloride, and infra-red spectroscopic methods.

Effect of sunlight and other factors on the toxicity of certain insecticides, by Mistic, (Jr.) W.J. and Martin, D.F., *J. Econ. Entomol.*, 1956, **49**, 757.—BHC, heptachlor, aldrin, toxaphane, dieldrin and Bayer 17147 were the insecticides tested against two insects viz., *Anthonomus grandis* and *Alabama argillacea*. BHC, heptachlor and aldrin proved ineffective in controlling the former insect following a 24-hour exposure of treated plant to 0.87" of natural rainfall. Toxaphane and dieldrin were still effective under these conditions. In the reduction of the potency of BHC, heptachlor and aldrin, high temperature appeared to play a major role and hence sunlight was not an important factor in reducing the effect. Considerable toxicity was retained at high temperatures by toxaphane and dieldrin and sunlight did not affect the toxicity of toxaphane but it was a major factor in reducing the toxicity of dieldrin. The residual effectiveness of Bayer 17147 was far superior to that of toxaphane even at low dosages. Repeated applications of either toxaphane or BHC at 5-day intervals did not result in accumulated toxic residues which could be measured in terms of either initial or residual control of the boll weevil. However, 1½ inches of

rainfall applied immediately after insecticide treatment was slightly more detrimental to effectiveness than rain occurring 24 hours after treatment. Rain slightly reduced the toxicity of toxaphane and parathion, appreciably reduced the toxicity of endrin and greatly reduced the toxicity of calcium arsenate.

S.V.P.

An evaluation of the use of sulphur dioxide in fumigant mixtures for grain treatment, by Kenaga, E.E., *J. Econ. Entomol.*, 1956, **49**, 723.—Sulfur dioxide has been tested under laboratory conditions to ascertain its synergistic value in fumigant mixtures and to know whether it could freshen and cool mouldy grain, reduce flash point of fumigants like carbon disulfide and reduce the moisture content of grain. Eventually, its penetration rate and sorption in the grain also was studied. It is shown that due to high sorption there is little penetration of the gas in the grain. The use of sulfur dioxide in grain fumigant mixtures did not appreciably affect residual insect kill, affect the moisture content of the grain, eliminate musty odour of the grain, cool the grain mass or safen the use of flammable CS₂—containing grain fumigants.

S.V.P.

MICROBIOLOGY

Energy supply and enzyme activity in strict anaerobes, studies on peptidase activity in *Clostridium Sporogenes*, by Johnstone, R.M. and Quastel, J.H., *Biochim. Biophys. Acta.*, 1957, **23** (2), 372.—Peptidase activity of resting cells of *Cl. sporogenes* is maintained optimally in presence of energy-yielding substrates. Under conditions where there is active breakdown of amino acids or of glucose in the presence of *Cl. sporogenes*, a relatively high rate of triglycine hydrolysis is observed. Interference with reactions of energy-producing substrates by ferricyanide or 2:4 dinitrophenol results in a decreased peptidase

activity. Ferrous, manganous and molybdate ions increase triglycine hydrolysis. The stimulations by ferrous and manganous ions are not additive. Peptidase activity of *Cl. sporogenes* is inhibited by versene and *aa*-dipyridyl, but not by cyanide or azide (10^{-2} M). Peptidase activity probably depends on thiol groups for activity, since it is inhibited by low concentrations of the arsenoxide, mapharsen. The addition of a heated extract of *Cl. sporogenes* to extracts of this organism increases the rate of triglycine hydrolysis. The stimulation is proportional to the ferrous ion concentration of the heated extract. It is suggested that the peptidase-iron complex necessary for optimal peptidase activity of *Cl. sporogenes* is of such a nature that it can be maintained under conditions where energy is supplied. In the absence of energy-yielding substrates, the complex deteriorates only to be restored by the addition of excess ferrous ions and thiol compounds.

Effect of Brewer's Yeast strain on flavobacterium proteus contaminants of brewery fermentations, by Strandkov, F.B. and Bockelmann, J.B., *J. Agric. Fd. Chem.*, 1956, **4** (11), 945.—The growth of *Flavobacterium proteus* during a brewery fermentation is affected by the strain of brewer's yeast employed. The extent to which *F. proteus* can grow in a brewery fermentation appears to be related inversely to the rate at which the yeast strain employed can deaminate certain amino acids.

GENERAL

Studies on the starch-synthesizing enzymes in tapioca (*Manihot utilissima*) roots, by Murthy, H.B. N. Rama Rao, G. and Swaminathan, M. *Enzymologia*, 1957, **18** (1), 63.—A study has been made of the starch-synthesising enzyme system in tapioca roots. Phosphorylase and Q-enzyme have been found in the juice obtained from the fresh tapioca roots. Methods for the purification of the two enzymes are described. Some of the properties

of the enzymes have been studied. The optimum pH and temperature for the action of the phosphorylase were 6.3 and 45°C respectively. Phosphorylase synthesized an amylose-type polysaccharide from glucose-1-phosphate. The quantity of inorganic phosphate liberated during the action of phosphorylase on glucose-1-phosphate was found to be proportional to the quantity of amylose formed. The optimum pH and temperature for the action of Q-enzyme were 6.9 and 31°C respectively. Q-enzyme converted amylose into a polysaccharide having properties similar to that of amylopectin. A similar polysaccharide was also formed by the combined action of phosphorylase and Q-enzyme on glucose-1-phosphate. Q-enzyme as found to exert a marked accelerating effect on the rate of synthesis of polysaccharide by phosphorylase from glucose-phosphate.

Stability of certain B vitamins exposed to ethylene oxide in the presence of choline chloride, by Bakerman, H., Romine, M., Schricker, J.A., Takahashi, S.M. and Mickelson, O., *J. agric. Fd. Chem.*, 1956, **4** (11), 956.—Exposure to ethylene oxide of crystalline B vitamins suspended in starch with choline chloride added resulted in the destruction of practically all the thiamine and large amounts of the riboflavin, pyridoxine, niacin, and folic acid. The effect of the ethylene oxide on thiamine may be due in part to the increase in pH that occurred in the presence of choline chloride. The alkalinity may explain the destruction of the thiamine but cannot explain the destruction of niacin, riboflavin, or folic acid. The mechanisms for the latter reactions are unknown. Cocarboxylase was also destroyed under the above conditions. About 40 per cent of the thiamine in a stock diet was destroyed following exposure to ethylene oxide. There was no destruction of pantothenic acid, biotin, or vitamin B₁₂ when the vitamin mixtures were exposed to ethylene oxide.

Dalda

and its place in the diet

In a recent address on "Fundamental Problems of Vitaminology," Prof. Wilhelm Stepp, Emeritus Director of the Munich Medical Clinic, observed: "Even authoritative writers hold that in this epoch when foodstuffs abound, vitamin deficiencies are no longer seen. This is a fundamental error."

Prof. Stepp cited as an example the U.S.A., one of the well-fed nations of the world. "The addition of vitamins to the flour used for bread now practised in the U.S.A. goes on to show that insufficient vitamins seem to be a great peril which must be avoided at all costs. In effect it is not possible to buy bakery flour in the U.S.A. which has not been reinforced with vitamins and some minerals."

If this is the case in America the condition must be far worse in a country like India where the intake of milk, milk products and other animal foods is extremely low. To quote from the special report No. 27 published by the Indian Council of Medical Research: "According to Health Bulletin No. 23 (1951), issued by the Nutrition Research Laboratories, Coonoor, *vitamin A deficiency is the single factor responsible for a large number of nutritional deficiency diseases*. The daily allowances for an adult are in the neighbourhood of 3,000 to 4,000 I.U. of vitamin A. Animal foods, which are rich in vitamin A, are however, many times more expensive; hence this rich source of vitamin A cannot be utilised."

With a view to making good a part of the vitamin A deficiency in this country the Food Fortification Sub-Committee of the Indian Council of Medical Research had recommended that the vitamin A content of vanaspati should be raised to 700 I.U. per oz. thus making available to the people a good and nourishing fat at an econo-

mical price. This has been done with Dalda.

Dalda is a pure cooking fat made out of vegetable oils according to strict Government specifications. The ordinary oils of everyday use are refined, hydrogenated and enriched with 700 I.U. of vitamin A per oz. and 56 I.U. of vitamin D per oz. By virtue of this enrichment the vitamin content of Dalda is now the same as that of good quality ghee.

Dalda is not a substitute for but an alternative to ghee. Fats like butter and ghee are good but their supply is far short of requirements and they are too expensive for the everyday use of most people. Further, the consumption of milk as milk is more beneficial than the consumption of ghee which is a product of milk, as then the consumer gets the animal protein as well as the calcium and vitamins. In most western countries people are increasingly consuming milk as milk. This should be the ideal trend in India also.

In addition to being a fat enriched with the two essential vitamins, Dalda is easily digested and utilised by the body on account of its low melting point. The standards of quality laid down for the manufacture of this product are so high that it compares favourably with its other counterparts such as "shortening" and "margarine" used extensively in the United States, England and other European countries. Each ounce of Dalda yields 250 calories, as much as 1 oz. of any good quality ghee and over twice as much as an ounce of wheat or rice.

Dalda is, therefore, a very valuable addition to the average Indian diet which is so often lacking in essential nutrients, particularly vitamins and fats.



FOOD SCIENCE

BULLETIN OF THE CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE

PASTE GOODS INDUSTRY IN INDIA—ITS PLACE AND PROSPECTS

Paste goods represent a large range of processed food products which are known and used all over the World. These have the advantage of being wholly or partially pre-cooked, are obtainable in a variety of attractive shapes and sizes, are easily prepared and used in diverse ways. The modern techniques of processing renders possible enrichment and fortification, so that the finished products can be made into well-balanced high class nutritious foods that can be consumed by all age groups and also made in bulk thus making it possible to be priced reasonably and brought within reach of all sections of people.

As the name suggests, the paste goods are made out of flour pastes or doughs. Any flour or even mixture of flours can be used for the purpose provided the mixture can be rendered suitable for easy processing. In India, we already have dozens of such products and we use them in a variety of ways. We do not, however, consume them in large quantities as a part of our diet as is the case in many other countries. Some of our products are used for cooking in water, but quite a number are used for frying in oil, vanaspati or ghee, as the case may be. *Papad* or *papadam* is one of the best known form of paste goods and depending on the ingenuity and taste, it can be made out of a variety of raw materials. The compositions of the pastes or doughs vary to some extent, with the raw materials and dietary habits of different regions, but the underlying principles for making them are the same. Most of these products are made in the homes and their preparation is a regular annual feature particularly during spring and early summer. There is no well organized major industry in this line, though products like *vermicelli* and *papad* can be purchased from the market in suitable packings.

Rice noodles (plain or with eggs, spinach and such other additives) are well known in the Far Eastern countries and form a large part of the

dietary of the people. In Siam, for instance, the noodles are consumed by a large section of people in preference to cooked rice. The rice used for the processing is generally of the glutinous type which is ideally suited for this purpose. Such varieties give pasty products on cooking in the usual way as rice, and hence are not very popular in our country. They are, however, specially grown for this purpose in other countries.

Macaroni products

The best known products among the paste goods are the class known as 'Macaroni' which are produced and consumed all over the World. Some authorities are of the opinion that all paste goods should be called 'Macaroni' products, but the latter have come to be specially associated with a certain type of raw material *viz.*, wheat flour or semolina. Macaroni, as the name implies is a product of Italian origin and its production and use has spread from that country to other parts of the World. Even today some of the best brands of 'Macaroni' products are powdered in Italy and the Italians wherever they are, have shown themselves to be connoisseurs in this line. There are no less than 250 types of macaroni products and some of them like macaroni, wheat noodles, spaghetti, shells, elbows and vermicelli are already being used in a large number of homes, hotels and restaurants in India. Although we have plentiful supply of raw materials, we are still dependent on other countries for the import of this category of processed food products. The price of the imported products is naturally high. In retail shops, the price varies from 75 nP. to Rs 1.75 per half pound packet. If made in our own country, with suitable machinery the product can be retailed *at a price which may be between half and one third of the present market price*. In that case, it can be reasonably expected that the off-take will be considerably more and

that there will be scope for organising large-scale production in different parts of the country.

The present World's production of wheat macaroni products may be placed at a few million tons every year. Of this, the major part is still being made either on home-scale or with small manufacturing units for which there is no adequate record. The organized factory production may be estimated at about 700,000 tons. Of this quantity, roughly about a half, is being produced in Italy. The production is however, fast increasing in several of the European countries, as also in North and South America.

The large-scale development of the industry started some decades ago with the mechanisation of the process. New improvements are coming up almost every year. At the present time, the mechanisation is so advanced that hardly two operators are required to run a big plant capable of making 40-50 tons per day. Additional staff are required only for unloading the raw materials, for packing and transporting the finished products, besides keeping the premises clean. Many of the plants are known to work almost non-stop for months together. Several of the recent installations, especially in South America are so big that they can continuously produce 100-120 tons of finished products per day. The large-scale machinery as now fabricated are largely designed to handle wheat products. Wheat has

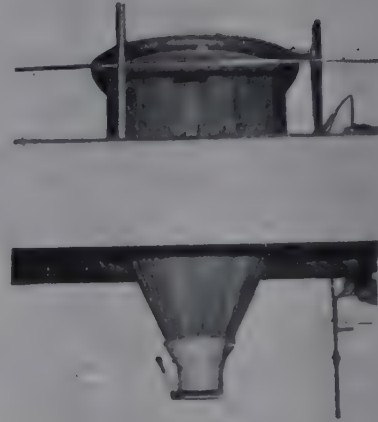
a unique advantage over all other grains in that it contains the protein gluten which can be easily extended with even a small percentage of water to make a good strong dough suitable for subsequent processing. Some varieties of hard wheat are exceptionally rich in gluten and they are best suited for the manufacture of macaroni products. Normally the addition of even 20-25 per cent of cold or lukewarm water would be sufficient to convert wheat semolina into a plastic dough. Flours from other grains or mixture of grains are not so easy to handle. In their case, dough strength has to be developed through gelatinisation of starch for which nearly 35 per cent or more of water is required or it can be achieved through special additives. Machinery can, however, be designed to suit such products. With some modifications, the existing machinery can also be adapted to such special processing technique.

Manufacturing process

In the ordinary household method, the mixing and kneading are done by hand. The dough can be extruded through a hand press and in a fair number of cases, products like vermicelli can be even drawn with the hand and then dried in the sun or shade. Such products will naturally be rather crude and heterogeneous. In the modern machinery, the same processes are put through with great rapidity and elegance. The flour or semolina is carried through conveyers and automatically introduced into the mixing tank in convenient instalments. The dosing of water is also regulated. The mixer then goes on operating continuously and feeds the dough into the extruding press, which to a large extent, also acts as a kneader. Application of vacuum improves the plasticity of the dough and helps in giving an attractive, translucent finished product. The dough is then forced under pressure through a die. In the case of short goods there is a cutter which goes on operating continuously and delivers the product, cut to the desired length, which is immediately carried into a pre-drier where hot air is blown. From the pre-drier, the product then passes into a continuous drier where the temperature and humidity are regulated. The drying generally takes 20-24 hours. The speed of movement of the product through the drier is so regulated that it is dried to the desired

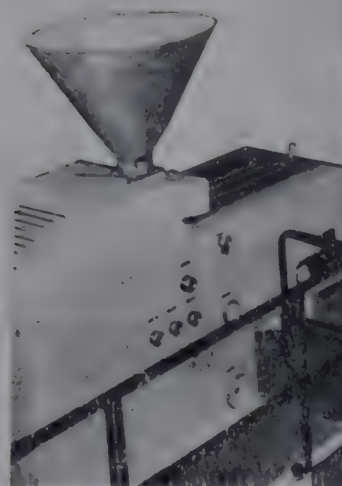
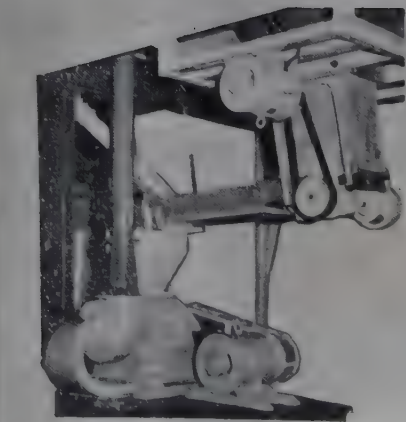
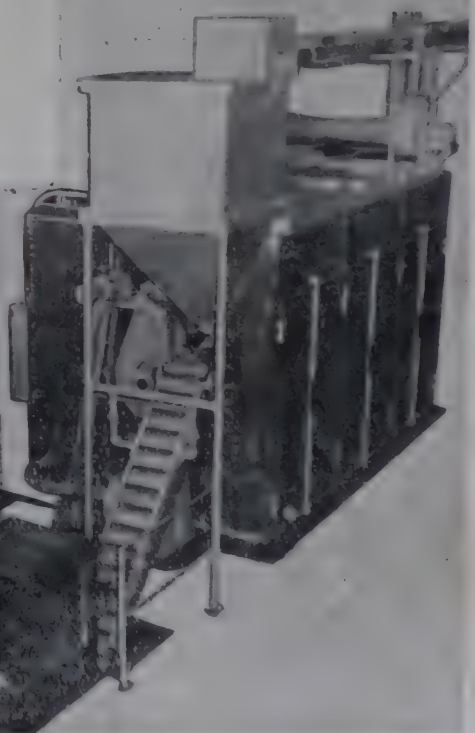
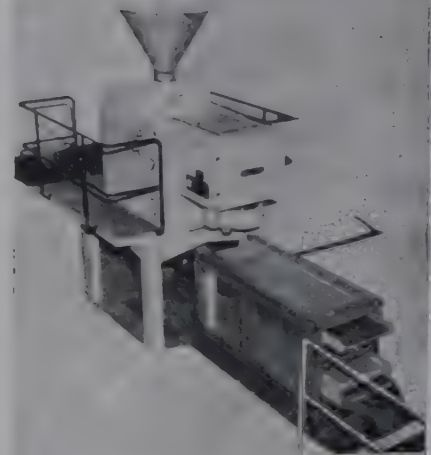
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PASTE GOODS PLANT

1. Grinding mill
2. Flour sifter
3. Mixing unit
4. Extrusion press
5. Pre-dryer and dehydrater
6. Section view of a dehydrater
7. Different shapes of paste goods
8. Research laboratory



extent at the time of discharge. The finished product is then automatically weighed and bagged for despatch.

In the case of long goods, such as spaghetti, the operation is a little more complicated. The product as it emerges through the die is cut to the desired lengths and then transferred to supporting poles which in turn are transferred to special types of driers where the humidity is adjusted in such

a way that the product does not suffer through cracking. The production and consumption of long goods is largely a matter of taste and fancy. Even the cooking and the eating of the cooked product are specialised processes requiring a good deal of experience. There are many experts who are of the opinion that the production and consumption of long goods is an unnecessary and elaborate routine and that short goods of the

same composition should do equally well. It has even been argued that in countries like India where 'Macaroni' products are not very familiar only short goods should be introduced.

Enriched products

In India where there is extensive malnutrition and where the diets are normally deficient not only in regard to proteins but also in respect of minerals and vitamins, there is a strong case to introduce and to popularise suitably enriched and fortified products. The Central Food Technological Research Institute, Mysore, has been making such an enriched product containing about 18 per cent protein and it has already found favour with consumers. The protein blend is suitably balanced so that its biological value is also quite high. Addition of necessary minerals especially calcium, as also vitamins, particularly those of the B-group will further improve the product without greatly enhancing the cost. The finished product *will thus be more nutritious* than any staple food grain and being very easy to digest is well utilized in the human body.

Processing of low-grade foods into balanced compositions

Processing of blended products is a comparatively new and difficult line. It does nevertheless offer possibilities not only for better utilisation of coarse types of foods, but also for enhancing the nutritive values of low-grade starchy foods and presenting them in attractive forms to the consumers. The Central Food Technological Research Institute has done a large amount of work in this line. An instance of the former is the conversion of a millet like jowar into a vermicelli type of product which even very young children, normally accustomed to rice, can digest. A more important development of a long range value not only to India but also to other parts of the world, has been the utilization of tapioca which is essentially a starchy and hence nutritionally poor food material for the preparation of a balanced type of product which is nutritionally superior to rice. The manufacture of such a product presents a number of problems especially when the cost of the product has to be low and it has to conform to the requirements of consumers ordinarily accustomed to rice. It is a difficult technological problem to prepare out of a weak dough a product

with the required shape that can also cook very easily. It has nevertheless been achieved. When cooked in the same way as a macaroni type of product, the preparation is easy to handle. The cooking time is very low (5-6 minutes as compared to 20-25 minutes for rice). The significance of this will be greatly appreciated when the uses are widely demonstrated through a well organized extension service programme. Such a product will also be of great value at places of high altitudes where cooking of rice grains is difficult.

Present plans and future outlook

The paste goods industry is still in its infancy. The present position is very much akin to the early days of the canning industry when a great deal of popular prejudice had to be overcome. Besides, technological improvements in the processing techniques have also yet to follow. The objective in view has to be that the finished product should be rendered hard and strong so as to withstand all the hazards of rough handling and transport in the same way as the natural grains. Even the ease of cooking is likely to be considered a disadvantage by the average consumer who is accustomed to the slow cooking qualities of the commoner grains. Improvements in the paste goods industry to produce grains which will have all the desired qualities of commoner grains are bound to follow, but they will take time. A useful beginning has been made with macaroni type products with tapioca as the major constituent and small percentages of wheat and groundnut flour for imparting strength to the dough and enriching its nutritional character. The product has been prepared in diverse shapes and sizes but our immediate effort will be to concentrate on the rice-shape grains which has a composition and nutritive value as shown below:

| | | Rice % | Tapioca macaroni products % |
|------------------------------|-----|-----------|--------------------------------|
| Moisture ... | ... | 12.5 | 10.6 |
| Protein (N × 6.25) ... | ... | 6.6 | 10.5 |
| Fat ... | ... | 0.5 | 1.9 |
| Ash ... | ... | 0.6 | 1.8 |
| Fibre ... | ... | 0.2 | 0.7 |
| Carbohydrates (by diff.) ... | ... | 79.6 | 73.8 |
| Calcium (Ca) ... | ... | 0.01 | 0.05 |
| Phosphorus (P) ... | ... | 0.12 | 0.14 |
| Iron (Fe) mg. ... | ... | 1.8 | 2.9 |
| Thiamine (mg) ... | ... | 0.11 | 0.22 |
| Nicotinic acid (mg) ... | ... | 1.2 | 3.7 |
| Riboflavin (mg) ... | ... | 0.02 | 0.07 |

The product has about 10 per cent protein and is nutritionally superior to rice. It has also the great advantage that it can be produced abundantly in regions like Kerala in our country and also in Ceylon, the regions which are short of rice but can grow large quantities of tapioca.

A line which offers immediate scope is the straight production of wheat macaroni products with which a large section of consumers are already familiar. The industry is best developed in conjunction with flour milling. The State should take steps to encourage the industry in its early stages and to avoid the risk of over-production. As the people realize the various advantages arising from the use of the products, the market is bound to expand.

Side by side with the above, there would be a scope for the introduction of new fortified and enriched products which need not cost much more than the plain wheat products. Gradually the former should replace the latter. The State can lay down the necessary specifications for the improved product. Independent of the above, the line of enriching low grade

foods and the production of attractive and acceptable products should be pursued. This is a difficult line and presents several scientific and technological problems. Some of these have already been wholly or partially solved. The solution of the others will follow in due course. Perfection is not attained all at once. A beginning has, however, to be made even with obvious short-comings provided a useful object is served.

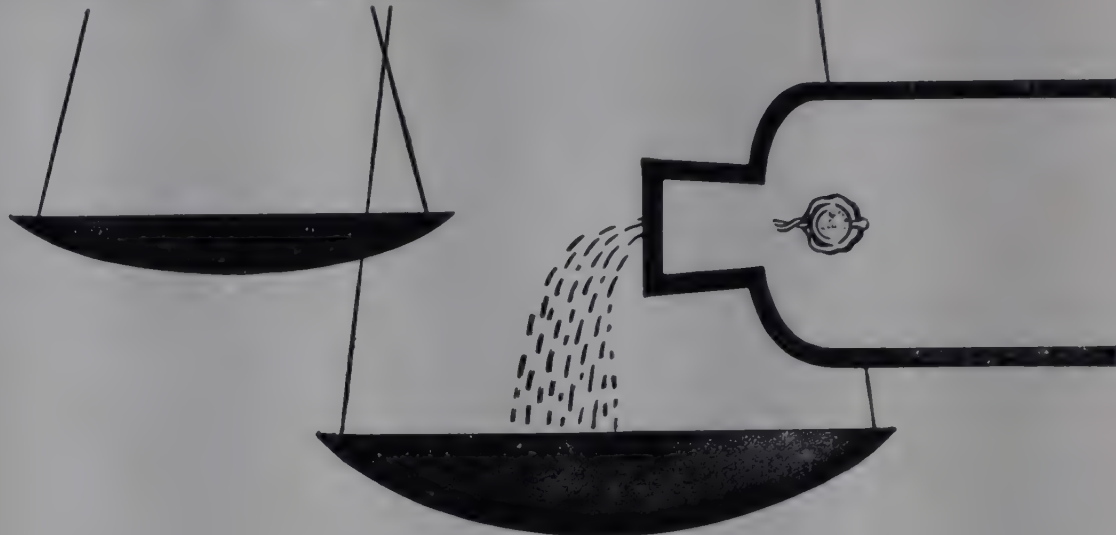
With the sympathetic interest and support of the Kerala Government, the Central Food Technological Research Institute, has made a useful beginning in this line. The enlightened public of the State can make a success of the effort if they identify themselves with the cause and show the best way to use the product in their daily menus. If this could be achieved, the State can show the way not only to the rest of India but also to the other parts of the World, the best means to nutritionally improve and otherwise utilize the available food resources without undue dependence on imports.

—V. SUBRAHMANYAN

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STUDIES ON THE STABILITY OF OILS IN PICKLES

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Different vegetable oils *viz*: sesame, groundnut, mustard and cocoanut oils are used in India in the preparation of a variety of pickles, both for domestic use and for export. The oil pickles are usually stored for a year or more, during which time they may sometimes develop rancidity. The off-flavours developed in the pickles during storage may be due to the development of oxidative and/or hydrolytic rancidity in the oil used in their preparation. The spices commonly added to the pickles may contain antioxidants and thus may help to a certain extent in retarding the development of rancidity¹⁻³. No information is available in the literature regarding the relative stability of different oils added to the pickles. The present report deals with studies on the stability of crude groundnut, sesame, cocoanut oils and refined cottonseed oil in mango and lime pickles.

Experimental

Preparation of pickles. Oil pickles were prepared using good quality lime and mangoes according to the recipes given in Table I. The lime and mango slices were mixed with salt and left for three days, after which the other ingredients were mixed. The different oils used in this study were: (1) refined cottonseed oil, (2) crude cocoanut oil, (3) crude groundnut oil and (4) crude sesame oil. The oils along with powdered asafoetida were heated at 60°C for 5 minutes, cooled and then added to the salted slices and mixed thoroughly to form the pickle. Quantity of oil used was sufficient to leave a thin layer at the top. The pickles were stored in glazed earthenware jars with lids, both at room temperature (25-30°C) and at 37°C.

Methods of analysis. For the determination of the acidity and peroxide values, the fat present in the pickles was extracted according to the method of Smith⁴ using chloroform instead of benzene. About 150 g. of the well mixed sample of the pickle was macerated and transferred to a conical flask. 150 ml. of chloroform was added. The mixture was

shaken for 2 hours and filtered. The filtrate was used for the determination of the oil content, and its peroxide and acid values.

The oil content of the pickle was determined in aliquots of 20 ml. of chloroform extract. The chloroform was first distilled off and the residual oil was dried at 100°C for 3 hours and weighed.

The peroxide values of the oils were determined according to the procedure of Wheeler⁵ using 20 ml. of the chloroform extract in each case.

The free fatty acids were determined using 20 ml. of the chloroform extract, chloroform being first distilled off and 20 ml. of neutral alcohol added to the residual oil. The free fatty acids present were determined according to the procedure of A.O.C.S.⁶ with the following modification. Since the fat extracted from the pickles was coloured red due to the presence of fat soluble pigments derived from the red chilli powder added to the pickles, it was found difficult to titrate the coloured alcohol extracts with alkali using phenolphthalein as the indicator. This difficulty was overcome by using thymol blue as the indicator and the titrations carried out until the end point was distinct green. The results of these determinations are presented in Table II.

The organoleptic acceptability trials were also carried out periodically with the help of a panel of six judges. The results are presented in Table III.

Results and Discussion

It may be seen from the results in Table II that the oils in the pickles stored at 37°C developed acid and peroxide values to a greater extent than those stored at room temperature. Among the oils tested, cocoanut oil showed the lowest peroxide values throughout the storage period while refined cottonseed oil showed the highest values. The stability of the different oils in the pickles ranged in the following descending order: cocoanut oil, groundnut oil, sesame oil and refined cottonseed oil. Studies on the stability of different oils subjected to different storage conditions

were carried out by many workers^{1,2,7} and the results are similar to those obtained in the present investigation.

No evidence of fungal damage was noticed in any pickle and this may be due to the fact that the pickles were covered with respective oils. It may be seen from Table III that the pickles containing cocoanut and groundnut oils and stored at room temperature and 37°C, were acceptable even after storage for 12 months. The pickles containing sesame oil were found to be slightly rancid at the end of the storage period of 12 months both at room temperature and 37°C, while the pickles containing refined cottonseed oil turned rancid when stored even at room temperature.

Summary

Mango and lime oil pickles were prepared using different oils *viz*: refined cottonseed, crude groundnut, cocoanut and sesame oils.

They were stored in glazed earthenware jars both at room temperature and 37°C. The stability of different oils was studied by determining periodically both acid and peroxide values.

The rate of development of rancidity in the different oils ranged in the following ascending order: cocoanut oil, groundnut oil, sesame oil, and refined cottonseed oil. Organoleptic evaluation showed that the pickles containing both crude cocoanut oil and groundnut oil were acceptable even after 12 months' storage at room temperature (25-30°C) and also at 37°C. Under the same conditions the pickles containing crude sesame oil were less acceptable while those containing refined cottonseed oil were unacceptable.

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TABLE I. Recipes used for lime and mango pickles

| Lime pickles | | | Weight (g) | Mango pickles | | | Weight (g) |
|-----------------|-----|-----|------------|-----------------|-----|-----|------------|
| Lime | ... | ... | 1000 | Mango | ... | ... | 1000 |
| Salt | ... | ... | 250 | Salt | ... | ... | 250 |
| Chilli powder | ... | ... | 150 | Chilli powder | ... | ... | 150 |
| Asafoetida | ... | ... | 8 | Mustard powder | ... | ... | 200 |
| Menthi powder | ... | ... | 10 | Asafoetida | ... | ... | 8 |
| Turmeric powder | ... | ... | 5 | Menthi powder | ... | ... | 10 |
| Oil | ... | ... | 500 | Turmeric powder | ... | ... | 5 |
| | | | | Oil | ... | ... | 500 |

TABLE II. Stability of oils in lime and mango pickles

| Name of Oil | | Free fatty acids (% oleic acid) | | | | | | | | Peroxide value (ml of 0.001 N. Thio per g. fat) | | | | | | | |
|--------------------------|-----|---------------------------------|-----|-----|------|------|-----|-----|------|---|----|------|------|------|-----|----|-------|
| | | Room temperature | | | | 37°C | | | | Room temperature | | | | 37°C | | | |
| Period in months | | 0 | 3 | 6 | 12 | 0 | 3 | 6 | 12 | 0 | 3 | 6 | 12 | 0 | 3 | 6 | 12 |
| <i>Lime pickle</i> | | | | | | | | | | | | | | | | | |
| Cottonseed oil (refined) | ... | 0.1 | 0.4 | 0.6 | 0.9 | 0.1 | 0.8 | 0.9 | 2.3 | 8 | 30 | 42 | 91.4 | 8 | 47 | 58 | 121.5 |
| Cocoanut oil (crude) | ... | 0 | 0.7 | 0.9 | 1.7 | 0 | 1.2 | 1.3 | 3.5 | 0 | 1 | 2 | 3.6 | 0 | 1 | 2 | 4.1 |
| Groundnut oil (crude) | ... | 2.5 | 4.5 | 5.0 | 6.6 | 2.5 | 5.0 | 5.8 | 10.5 | 3 | 8 | 12 | 19.4 | 3 | 11 | 16 | 20.6 |
| Sesame oil (crude) | ... | 0 | 0.4 | 0.6 | 3.2 | 0 | 0.6 | 1.0 | 5.4 | 0 | 3 | 6 | 39.0 | 0 | 8.5 | 12 | 41.8 |
| <i>Mango pickle</i> | | | | | | | | | | | | | | | | | |
| Cottonseed oil (refined) | ... | 0.1 | 0.6 | 1.2 | 4.5 | 0.1 | 0.8 | 2.1 | 3.7 | 8 | 57 | 62 | 67.8 | 8 | 65 | 71 | 77.7 |
| Cocoanut oil (crude) | ... | 0 | 1.3 | 2.4 | 3.2 | 0 | 1.9 | 2.4 | 5.3 | 0 | 2 | 7.2 | 15.6 | 0 | 3 | 11 | 19.4 |
| Groundnut oil (crude) | ... | 2.5 | 5.1 | 8.9 | 12.8 | 2.5 | 6.3 | 8.9 | 14.5 | 3 | 7 | 13.4 | 23.9 | 3 | 21 | 25 | 30.1 |
| Sesame oil (crude) | ... | 0 | 1.3 | 2.3 | 3.6 | 0 | 1.6 | 2.3 | 5.4 | 1 | 20 | 29.0 | 38.0 | 1 | 26 | 33 | 43.9 |

TABLE III. *Organoleptic evaluation of the lime and mango pickles*

| Name of the Oil | Temp. of Storage | Lime Pickle | | | Mango Pickle | | |
|--------------------------|------------------|----------------------------|-----------------|--------------------|----------------------------|--------------|--------------------|
| | | Period of Storage (months) | | | Period of Storage (months) | | |
| | | 3 | 6 | 12 | 3 | 6 | 12 |
| Cottonseed oil (refined) | { R.T* 37°C | A N.A | A(S.R.) N.A. | N.A. N.A. | N.A. N.A. | N.A. N.A. | N.A. N.A. |
| Cocoonut oil (crude) ... | { R.T. 37°C | A A | A A | A A | A A | A A | A A |
| Groundnut oil (crude) | { R.T. 37°C | A A | A A | A A(S.R.) | A A | A A | A A(S.R.) |
| Sesame oil (crude) ... | { R.T. 37°C | A A | A A | A(S.R.) A(S.R.) | A A | A A | A(S.R.) A(S.R.) |

A=Acceptable, A.(S.R.)=Acceptable (but slightly rancid).

N.A.=Not acceptable (rancid), *R.T.=25°C–30°C.

SCIENCE NOTES

ANALYSIS OF SHATI-FOOD

Shati-food is a product obtained from the rhizome, *Curcuma zedoaria* (Zinziberaecae), its name in different Indian languages being: Hindi, Bengali, Marathi, Kannada, Gujarathi as *Kachura*; Tamil—*Kichili-kizhanghu*; Telugu—*Kachorum*; Malayalam—*Pula-kizhanna*. The plant grows wildly in the Eastern Himalayan range and in the moist deciduous forests of the coastal tract of Canara. It is a native of north east India and is widely cultivated in many parts of India, Ceylon and China¹. The arecanut plantations which provide shady conditions and the banks of irrigation channels are congenial for the cultivation of *C. zedoaria*.

The rhizome is a large fleshy tuber. It is cut into thin transverse sections and dried. The dried slices, greyish buff in colour, have an agreeable musky odour with camphorus note. They are pungent and bitter in taste. The dried chips have a good export market.

The starch known as 'Shati-food' is manufactured from the *C. zedoaria* as follows: The tubers are washed and peeled. The peeled tubers are sliced and made into a paste with water. The paste is allowed to settle for the starch. The supernatant liquid is drained off and the sediment is repeatedly washed with water till white starch, free from bitterness, is obtained. This starch is then dried in the sun².

Mukherji *et al*³ analysed a sample of 'Shati-food' for moisture, ash and starch contents. Their figures were: moisture, 13.1 per cent; ash, 1.0 per cent and starch, 82.6 per cent. Considerable work has been reported by Sanjiva Rao and co-workers⁴ on the aromatic principles of *C. zedoaria*.

The present study deals with the chemical composition and *in vitro* digestibility studies of a sample of 'Shati-food' obtained from the Secretary, Rehabilitation Department, Tripura Administration, Assam.

Experimental

The original material, which was in a lumpy condition was finely powdered to 60 mesh and moisture, ash, crude fibre, starch, calcium and phosphorus were estimated according to the methods of analysis of the Association of Official Agricultural Chemists⁵. Protein was estimated by the micro-kjeldahl method. The data are given in Table I.

TABLE I. *Chemical composition of Shati-food*

| | | | | | | |
|--------------------------|-----|-----|-----|-----|-----|------|
| Moisture% | ... | ... | ... | ... | ... | 13.0 |
| Protein% (N × 6.25) | ... | ... | ... | ... | ... | 0.3 |
| Starch% | ... | ... | ... | ... | ... | 86.4 |
| Ash% | ... | ... | ... | ... | ... | 0.7 |
| Fat% (Ether extractives) | ... | ... | ... | ... | ... | 0.1 |
| Crude fibre% | ... | ... | ... | ... | ... | Nil |
| Calcium mg% | ... | ... | ... | ... | ... | 41.0 |
| Phosphorus mg% | ... | ... | ... | ... | ... | 18.0 |

In vitro digestibility of starch was determined as follows: 400 ml. of 2 per cent solution of Shati-food was mixed with 100 ml. of phosphate buffer pH 6.8 followed by 1 ml. of 1 per cent NaCl solution and 1 ml. of salivary amylase (diluted 1:1 with 1 per cent NaCl solution). The individual components were brought to 37°C before mixing. The reaction mixture was then incubated at 37°C layered with toluene and 1 ml. of the reaction mixture was drawn at intervals. The quantity of reducing sugars formed was determined according to the method of American Association of Cereal Chemists⁶. Maize starch was taken for comparison in the *in vitro* digestibility studies. The data are presented in Fig. 1.

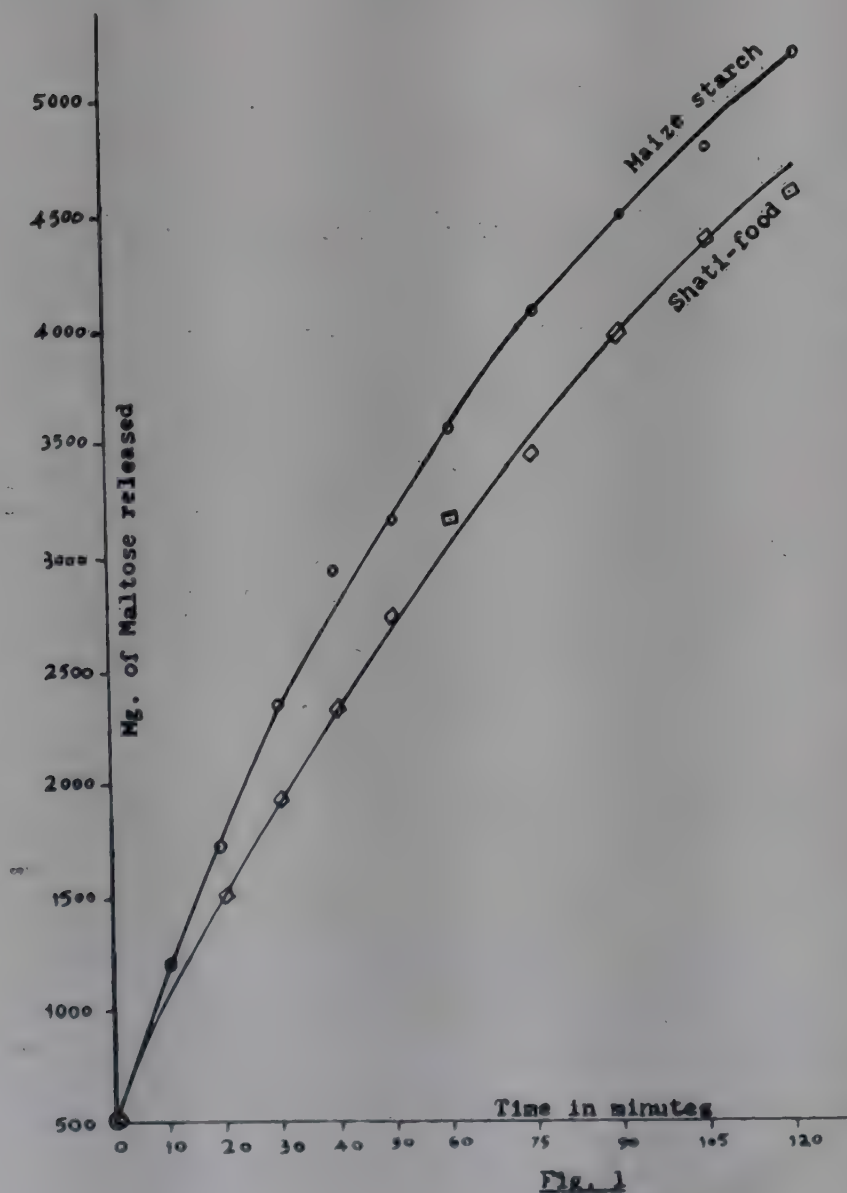
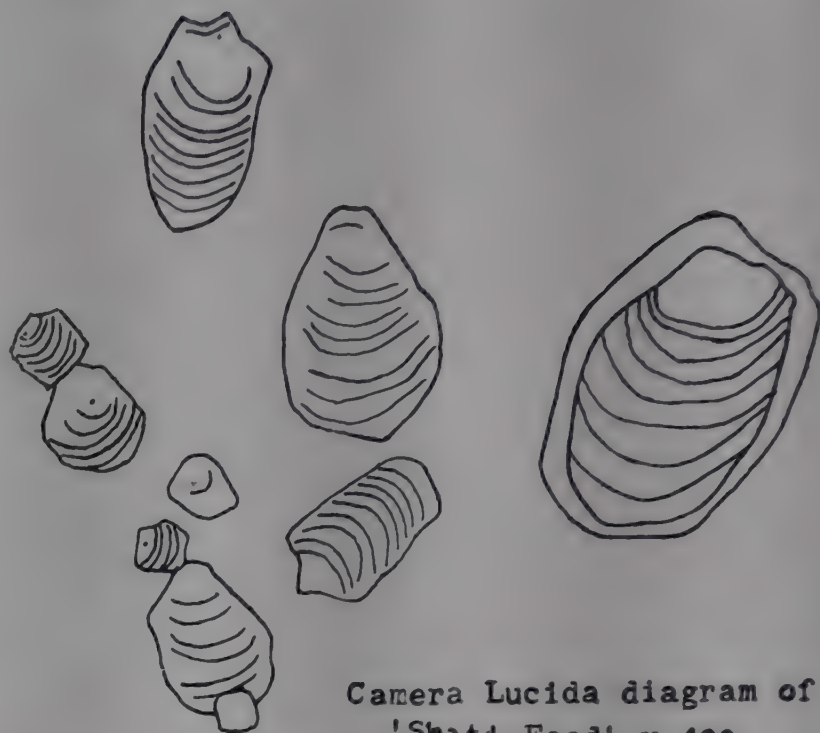


Fig. 1

Microscopic examination of 'Shati-food' showed that it closely resembles arrowroot starch. Camera lucida diagram of the material is given in Fig. 2.



Camera Lucida diagram of
'Shati-Food' x 400

Fig. 2

The results are in conformity with the findings of Mukherji³ that Shati-food is predominantly a starchy food. There does not appear to be much difference in the digestibility of 'Shati-food' and maize starch by the action of salivary amylase.

The author's thanks are due to Drs V. Subrahmanyam and M. Srinivasan for their kind interest in this investigation and to Shri K. B. Mathur, Secretary, Rehabilitation Department, Tripura, for kindly supplying the material.

Central Food Technological
Research Institute, Mysore

S. B. KADKOL

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CANNING OF FISH*

Canning is the application of heat to food products in hermetically sealed containers at a temperature and for a period of time sufficient to destroy any yeast, molds, and enzymes and to destroy or inactivate any bacterial organisms that may cause spoilage. This heat treatment, or processing, serves another purpose besides sterilization. It produces a ready cooked product. Improvements in quality often result, but the temperature and time of processing must be closely controlled if optimum results with respect to taste, colour, and nutrition are to be obtained. The method of processing that will give the most satisfactory results has been developed for each individual fishery product.

In the commercial canning of fishery products only two types of containers are in general use in the United States, the tin can and the glass jar. Aluminium containers are used in Norway. It is estimated that 95 per cent of the production of fishery products is packed in tin containers.

The canning of fish may be divided into a number of definite steps which are more or less similar for all products but vary with respect to details in the processing and the methods employed. These steps are listed in the order of their applications: Securing the fish; Transporting and receiving; Grading; Dressing and washing; Preparation for the can; Filling the can; Sealing; Processing; Cooling and washing; Coding; Warehousing and Labelling.

Dressing and washing is the first step in the actual process of manufacturing the canned product. In the dressing operation the viscera and other waste materials are removed. Washing removes the blood, slime and dirt.

After being washed and cleaned the fish are cut usually in can length portions. Some canneries are equipped with filling machines which take the whole cleaned fish and cut them

into suitable lengths just before they reach the empty cans. The cans can also be filled automatically by filling machines or they may be filled by hand.

The old system of obtaining a partial vacuum in the can is by heating the material and sealing the can immediately. On floating canneries where space is at a premium, and in modern plants, a vacuum sealing machine which combines the functions of exhausting and sealing is now being used to advantage.

The processing or cooking is done in a large retort which should be equipped with automatic temperature control equipment, an indicating thermometer, a recording thermometer, a sensitive steam pressure gauge, blow off vents, steam inlet pipe and a drainage valve. Accurate control of temperature and time of cooking is necessary to obtain a uniform finished product of high quality.

The cans are cooled and cleaned after leaving the retort. Cooling is done as rapidly as possible because if prolonged, the product may become darkened in colour and overcooked in flavour. Cooling is done sometimes in the retort by water cooling under controlled conditions with respect to time, pressure and temperature.

Coding, which is a system of marking or stamping the cover of the can with a die, is used to identify any container so that a full knowledge and record can be kept of any pack. The most important function of coding is to enable the packer to determine better the grade of the product and improve its quality by correcting faults in workmanship and packing.

Warehousing and labelling of the cans are necessary steps in the marketing of the finished product. A good label aids considerably in marketing especially if many of the consumers cannot read, they depend upon the picture to identify the contents of the can.

* Digested from the February 1945 issue of *Guide to the Industrialization of China*. Copyright 1945 by Foreign Economic Administration, Washington, D.C. Reprinted with permission from the United States Technical Co-operation Mission to India. Further reproduction is prohibited.

Note 1: One of the most important factors in the canning of fish is the availability of an adequate supply of good fresh water. All water used around a cannery should be of good drinking quality, free from any possibility of sewage contamination. Water is required in large quantities for cleaning and washing operations. Salt water should not be used because it can be contaminated with spoilage organisms. The water supply should be sampled and analysed to determine whether it is safe for use. The amount of water required will vary in accordance with the product being canned, the process, and the type of equipment used. The water used for cleaning should be furnished in at least $1\frac{1}{2}$ inches diameter pipes and at a minimum pressure of 50 pounds per square inch. Water outlets should be provided and readily accessible so that long lengths of hose need not be dragged over the floor and around the equipment for flushing the tables, machinery, floors, walls, and ceilings.

Note 2: Steam is required for both processing and cleaning. The amount of steam necessary to operate a fish cannery may be estimated at one half boiler-horsepower per case of production capacity. A cannery with a maximum capacity of 1,000 cases per day, therefore, will require 500 boiler-horsepower. Two boilers, each of sufficient capacity to meet the daily steam requirements, should be installed so that it is not necessary for the cannery to discontinue operation in case a boiler must be cleaned or repaired. A plant with a daily capacity of 1,000 cases would then require two 500 boiler-horsepower capacity steam boilers.

Note 3: In warm climates, finely crushed ice should be available for maintaining the freshly caught fish in good condition while they are being hauled to the cannery. It is estimated that for average condition, at least 50 pounds of ice are required for each 100 pounds of raw material.

P A R M A (Italy)

20th—30th September, 1957

Twelfth **INTERNATIONAL FAIR for
PRESERVED FOODS and PACKING
INTERNATIONAL EXHIBITION**
of
FOOD PRODUCTS EQUIPMENT

P A R M A
(Italy)

1957

The various DISPLAYS cover
MACHINERY and ACCESSORIES for producing and packing preserves, dairy produce, edible oils, bread and other cereal products, rice flour mill equipment, confectionery and cake and biscuit manufacture, bottling, wine trade, mineral water production, malting and brewing, cold storage, sugar refining.
SCIENTIFIC INSTRUMENTS and APPARATUS for the foregoing industries.
PACKING, CONTAINERS and ACCESSORIES for all the food industries.
PACKED FOODS—Vegetable, Animal, Fish, Milk Extracts and Soup Cubes, Fruit Juices and Syrups
RAW MATERIALS for the food industries.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during April 1957 are given below:

S (IS) 203 (150)

Thermal processing (spin-pasteurization) of citrus concentrates, by Pruthi, J.S. (April 6, 1957.)—Reviewing briefly the progress made in citrus concentrate industry the speaker stated that the two major problems still facing this industry were the development of off-flavour and gelation. He then discussed the four basic factors responsible for gelation *viz.*, pectin-concentration, pectin-methyl-esterase activity, pH and bivalent ion concentration and then correlated them to the technological problems encountered both during processing and storage. Narrating the limitations of the two hitherto commercially practised methods of preservation of citrus concentrates—*viz.*, freezing and sulphitation, he then discussed only the important results achieved by him while on deputation at C.S.I.R.O. in Australia on the thermal processing (Spin-Pasteurization) of Valencia orange concentrate.

The study covered 3 important aspects, *viz.*, (1) heat-transfer, (2) process evaluation and (3) storage.

Using 'Speedomax' single-point recording potentiometer and copper-constantan thermocouples, data were presented on the effect of head-space, speed of can rotation, container size, degree of concentration, retort temperature, degree of vacuumization, etc., on the rate and mode of heat penetration. Summing up, he stated that spin-heating in atmospheric steam at 206-207°F of orange concentrate (42° Brix) when packed in 202 × 214 cans with 1/4" head-space and rotated axially at 150 r.p.m. for 75 seconds will give a can centre temperature of about

175°F. This when followed by spin-cooling under sprays of tap water for a period of 2 1/4 minutes, will give a can centre temperature of about 95°F. There were negligible losses in ascorbic acid and carotene during the spin-processing. This process, as revealed by the later experiments on thermal resistance of yeast, proved very safe.

He went on to state that scientific determination of processes for canned foods involves the correlation of the actual data on heat penetration (as obtained above) with the data on the thermal resistance of the most heat-resistant organism causing spoilage in the food under reference. The data collected on the thermal resistance of the most heat-resistant isolate from orange concentrate were then presented.

The natural contaminants found in the Valencia orange concentrate were isolated and found to be a strain of yeast. Using T.D.T. Pyrex tubes, the 'D' values (*i.e.*, the decimal reduction time in minutes) for the yeast at 60°, 65° and 70°C worked out to 5.8, 0.64 and 0.09 respectively. Under the conditions of experiments, pH had only very slight effect on the thermal resistance of the yeast, the 'D' values at 55°C at 3 levels of pH *viz.*, 3.50, 3.75 and 4.00 being of the order of 11.80, 12.09 and 12.46 respectively. The 'z' values worked out to 9.9. The F_0 value was worked out by the graphical method and the total process had a lethal value of 18 times that at the newly suggested reference temperature of 175°F. F_{175} was 0.76 seconds.

With a view to compare the rela-

tive efficiency of the recommended spin-process with the conventional methods of preservation of citrus concentrates namely sulphitation and freezing, storage tests were conducted at different temperatures over a period of one year. The storage aspects covered were concavity and flip vacuum loss, changes in head-space gas composition with special reference to CO₂, H₂ and O₂; degree of corrosion, tin and iron pick-up; physico-chemical changes with respect to ascorbic acid, carotene, sugars, pH, viscosity flavour and colour as evaluated from absorption spectra and spectral reflectance curves, etc. The main conclusions were:

(i) Spin-pasteurized Valencia orange concentrate (42° Brix) when stored at 41°F (5°C) was as good as the frozen concentrate in practically all aspects.

(ii) Both frozen and spin-processed orange concentrate were far superior in flavour to the sulphited concentrate.

(iii) At tropical temperature of storage (86°F), however, considerable deterioration in colour and flavour occurred even during 6 months' storage of both sulphited and spin-processed concentrate, the latter lost all the vacuum by the end of 9 months and developed 5 lb. pressure by 12 months' storage as a result of production of considerable amounts of CO₂ and H₂. However, at high temperature, most of the oxygen in the head-space was consumed within the first 2-3 months, being used up for the oxidation of ascorbic acid and in chemically combining with H₂ produced as a result of corrosion.

(iv) Ascorbic acid losses in frozen, refrigerated and incubated spin-processed concentrate were of the order of 5, 8 and 85 per cent respectively. The corresponding losses in carotene were 0, 5 and 20 per cent.

While concluding, the speaker briefly indicated the future possibilities in spin-processing of mango slices, orange segments and other viscous fruit products. Covering the economic aspects he stated that by replacing the conventional method of stationary heat-processing of several fruit products by the spin-processing method, the processing charges, depending upon the nature of the product, could be reduced from one-half to one-tenth with the added advantages of better retention of flavour, colour and nutritive value.

The talk was followed by an interesting discussion and important points raised were, the efficacy of the process, inactivation of pectin methyl esterase, shelf-life of concentrate under tropical conditions, spin-processing Vs H.T.S.T., designing of containers and rate of heat transfer. The President then, in his concluding remarks said that we should shortly start the work on similar lines on the application of spin-processing to other fruit products. He further stressed the need of a detailed study on development of 'off' flavours and CO₂ production in other concentrates and fruit products.

S (IS) 204 (151)

Feeding experiments on children with Indian Multipurpose Food, by Swaminathan, M., (*April, 20, 1957*).—At the outset the speaker mentioned that in an earlier seminar, investigations relating to the production and nutritive value of the Indian Multipurpose Food have been discussed. During the last one year further investigations were carried out on children with a view to find out (1) the effect of supplementing the diet of school children daily with 2 oz. of Multipurpose Food on their growth and nutritional status (2) the effect of Multipurpose Food supplement on the

metabolism of protein, calcium and phosphorus in children and (3) the usefulness of the Multipurpose Food containing 20 per cent skim milk powder (formula C) in the treatment of nutritional oedema syndrome.

Feeding experiments were carried out on 46 girls aged between 4-10 years in an orphanage in Mysore. The children selected for the experiment were free from any disease likely to interfere with the experiment. The height, weight, haemoglobin content, R.B.C. count and the nutritional status of all the children were determined. On the basis of the initial heights and weights, the children were paired and the members of each pair allotted at random to two groups of 23 each. Both the groups received the usual orphanage diet. The orphanage diet, as determined by a diet survey, was inadequate with respect to calories, protein, calcium, Vitamin A and riboflavin. Each child in one of the groups received daily a supplement of 2 oz. of Multipurpose Food given either in the form of soup or chutney along with lunch and dinner. Two ounces of the supplement provided the following quantities of different nutrients: protein 20.6 g., calcium 280 mg.; phosphorus 370 mg.; thiamine 0.8 mg; riboflavin 1.7 mg; nicotinic acid 7.9 mg.; vitamin A 1704 I.U.; vitamin D 170 I.U. The supplement made up to a great extent most of the deficiencies in the diet except calories. In order to equalise the calorie intake of the two groups, each child in the control group was given daily a starch pudding prepared from one ounce of corn starch and one ounce of sugar. The feeding was continued for a period of 5 months at the end of which measurements of height, weight, R.B.C. count, haemoglobin and nutritional status were made. The results on statistical analysis showed that the average increase in height, weight, R.B.C. count, and haemoglobin level in the experimental group receiving Multipurpose Food supplement was larger than that observed in the control group; and difference

being highly significant (0.1 per cent level) with respect to weight, height, and haemoglobin. Eighteen children in the experimental group improved in their nutritional status as compared with control. On the other hand thirteen children in the control group showed deterioration while none in the experimental group. The results clearly indicated that a daily supplement of 2 oz. of Multipurpose Food for a period of 5 months produced a marked improvement in the growth and nutritional status of the undernourished.

In view of the marked improvement in the growth and nutritional status of children observed in the above experiment, it was considered of interest to investigate metabolism of nitrogen, calcium and phosphorus in children from both the groups. The metabolism study was carried out when the above experiment had progressed about 3 months. Five pairs of children aged 8-10 years were selected from the control and experimental groups. The composition of the diet and the supplements were the same as that described in the above experiment. Weighed amounts of food were given to each child during the metabolism period which lasted for 5 days. Complete duplicates of the food given, were collected, dried and analysed for nitrogen, calcium and phosphorus. The urine and feces were collected daily for a period of 5 days and were analysed for nitrogen, calcium and phosphorus. The results showed that the retention of nitrogen, calcium and phosphorus in children receiving Multipurpose Food was nearly twice that observed in children not receiving it, the difference being significant at 5 per cent level in all the cases.

The speaker next described the studies relating to the treatment of cases of protein malnutrition (Nutritional oedema Syndrome) with the multipurpose food containing 20 per cent skimmed milk powder. He further pointed out that so far skim milk powder imported from abroad has been used widely in the treatment of protein malnutrition. More recently, encouraging

results have been reported in the treatment of the disease with the soyabean and bengal gram. In view of the widespread incidence of protein malnutrition in India, and the shortage in the supply of skim milk powder, it was considered of interest to investigate the suitability of the multipurpose food containing 20 per cent skim milk powder for the treatment of protein malnutrition.

Three cases (aged 2-3 years) suffering from the nutritional oedema syndrome, were admitted as in-patients in the Holdsworth Memorial Hospital, Mysore. Each child was given daily about 2 ounces of the product on the first 2 days and then 4-5 ounces afterwards. The product was given in 4 doses in the form of a thick gruel sweetened with sugar. A marked improve-

ment in the general condition of the patients was observed within 8-10 days. Oedema began to subside from the 6th to 8th day and completely disappeared after treatment for about 3-4 weeks. The treatment was continued for a period of 6 to 8 weeks. All the cases were completely cured and looked quite normal at the time of discharge.

The serum proteins, haemoglobin and the R.B.C. count of the blood were determined before and after treatment. The total serum protein and albumin levels which were below normal, returned to the normal level. A moderate increase in haemoglobin and R.B.C. count were also observed. The results indicated that the multipurpose food containing 20 per cent skim milk powder could be used for

the treatment of moderately severe cases of protein malnutrition.

The discussion that followed covered points such as clinical trials now in progress on protein rich foods under the auspices of Indian Council of Medical Research in Coonoor, Madras and other centres. The need for raising the calorie intake of experimental subjects for obtaining better growth response with protein supplements, the cost of production of the product, and the effect of high protein supplements on the adult human system.

The President in his concluding remarks stressed the need for a large scale production of the multipurpose food and its distribution at a low cost so that the low income groups of the population who need it most, will benefit.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Salad Oil

E (IS) 29171 (360)

I would be grateful if you could let me have some information about salad oil. Has any standard been set for such an oil in India? (Bombay).

Any refined liquid vegetable oil which does not deposit stearine on standing is called 'salad oil'. The cooking oil may be any edible oil, but a salad oil other than olive oil is generally understood to be one which will not solidify at ordinary domestic refrigerated temperatures of 40-45°F. The crude edible oil has to be therefore refined, bleached to make it tasteless and odourless and then winterised so that even when it is kept at low temperature it does not solidify or deposit anything.

In India, no standard has been

fixed for salad oil except the fact that it should remain as a liquid at low temperatures. In trading, a salad oil is defined as one which will not show evidence of 'clouding' (from crystal formation) when a sample is immersed in an ice and water bath (32°F) for 5½ hours. Such an oil will not only pour from its container when cooled but will also not crystallise and break the emulsion of mayonnaise type salad dressing.

Natural cottonseed oil solidifies at the above mentioned temperatures and so it must be winterised to produce a salad oil. In this process the oil is chilled slowly to about 45°F and the precipitated solid crystals are removed by filtration leaving a salad oil. Corn oil is a natural winter oil and most of the corn oil produced in the United

States is sold as salad oil. Soyabean oil requires the removal of very small quantity of wax from it to prevent clouding at low temperatures. The flavour reversion of unhydrogenated soyabean oil makes it less desirable for salad oil than cottonseed oil. Sun-flower-seed and sesame oils are excellent natural salad oils, but peanut oil is not used for salad oil because at the winterising temperatures very little liquid oil can be recovered.

Preparation of beaten rice and parched rice

E (IS) 29420 (361)

Kindly let me know the method of preparation of beaten rice and parched rice. (Nellore)

For the preparation of beaten rice, paddy is steeped in water at a

temperature of about 60-70°C and is kept overnight in contact with water during which time it is allowed to cool. The water is then drained off. A small quantity of about one lb. of paddy at a time is put in a frying pan, dried by heating the paddy till it just begins to crack, and then beaten in a mortar while still hot by means of a wooden pestle. The material is finally winnowed to remove the chaff when beaten rice is obtained.

Parched rice is prepared as follows: Paddy is sprinkled with a little water or with a solution of common salt in water to give the saltish taste. The paddy is then mixed with about four times its own volume of pre-heated sand contained in the frying pan kept on an open fire, the temperature of the sand being about 240°C. The paddy is now parched (roasted) till it blooms to full size by rapid mixing in the pan by means of a ladle. The parched material is then separated from the sand by sieving.

Manufacture of corn flakes

E (IS) 29301 (362)

Would you please furnish me the details of the manufacture of corn flakes? (East Godavari Dist.)

Corn grits (hominy grits) are prepared by grinding and sifting cleaned white corn, with removal of bran and germ. Only the larger sizes of grits which will pass through a No. 4 sieve but will be retained on No. 6 sieve are selected. These grits are mixed with malt extract and salt and cooked in rotary steam cookers with steam for 2-2½ hours. The cooked grits are dried to a waxy consistency (approximately 15 per cent moisture) and then passed between steam-heated steel rollers revolving at different speeds. After rolling in this manner, the flakes are carefully dried and toasted. Corn flakes being hygroscopic, it is necessary to pack them in water-resistant packages, generally containers with waxed paper inner bags or waxed paper outer wrappers. Vitamins are added just prior to packaging because thiamine is not

thermostable and cannot be added at any other step in the process. Corn flakes thus obtained are used as a ready-to-serve cereal breakfast food.

Manufacture of quaker rolled oats

E (IS) 29301 (363)

What is the method of manufacturing quaker rolled oats? (East Godavari Dist.)

Cleaned oats are dried in a rotary drier to a moisture content of 6-12 per cent. After cooling, the oats are separated into different sizes. The graded oats are now hulled to liberate the 'groats' which are then separated from the hulls, dust, grain hairs and unhulled oats. The cleaned groats are cooked in digesters with steam, after which they are rolled between large steam-heated rollers. These rolls crush the groats to form the well-known flakes of rolled oats. If quick-cooking rolled oats are desired, the groats are steel-cut into pieces of varying size, the pieces are cooked as before and rolled into thin flakes.

The rolled oats should not contain more than 12 per cent moisture, not more than 1.5 per cent crude fibre, not less than 2.24 per cent of nitrogen and not more than 2.2 per cent ash.

Preparation of invertase enzyme

E (IS) 29133 (364)

Will you kindly write to me the details of the method of preparation of invertase enzyme? (Bombay).

The choice of the method for 'Invertase' enzyme preparation depends upon three factors.

(i) Degree of purity of the enzyme.

(ii) Activity of the enzyme.

(iii) Stability of the enzyme during storage.

The preparation of commercial 'Invertase' enzyme is covered by patent in a number of countries but in most of the commercial methods

the drastic purification steps are not used as this is not necessary for the technical product. On the other hand the activity and stability of the product is of prime importance.

The activity and yield of enzyme will depend upon the strain of yeast used. One has to adopt such method, which may be suitable to their conditions including economic factor. However, in the commercial preparation of enzymes, the following steps are involved.

(i) Yeast stimulation.

(ii) Autolysis of yeast cells.

(iii) Precipitation of enzyme from autolyzate.

and (iv) Drying and packing of the enzyme.

Source of yeast. Any Brewer's yeast, baker's yeast or Distiller's yeast can be used for the extraction of enzymes. The most suitable strains of yeast are *Saccharomyces carlsbergensis* or *Saccharomyces cerevisiae*.

Yeast stimulation. 200 g. of bottom yeasts from the above source is suspended in 4 liters of nutrient broth containing 8 g. of secondary ammonium phosphate, 8 g. primary potassium phosphate, 2 g. of magnesium nitrate and 2 g. of potassium nitrate.

The mixture is aerated for 8 hours at the rate of 500 liters of air per hour with the aid of copper perforated tube as a sparger. At the same time 1 L of 12 per cent sucrose solution is added dropwise, while the temperature is maintained at 30°C and the pH at 4.5.

Autolysis of the yeast cells. 48 kg. of such yeast is liquified with 4.8 liters of the toluene for 3 hours. The mixture is diluted with 48 liters of water. The mixture is adjusted to a pH of 5.8 by the addition of about one liter of 2.5 per cent ammonium hydroxide solution. The autolysis is thus carried out for about a period of 24 hours at 30°C. It is then adjusted to pH 4.7 with the addition of about 700 c.c. of 30 per cent acetic acid. The autolyzate is separated by centrifuge. This will yield about 68 L autolyzate con-

taining about 81.6 per cent of the original invertase.

Precipitation of enzyme from autolyzate. Centrifuged autolyzate is precipitated with isopropyl alcohol and dried at low temperature or the alternate process is the precipitation of enzyme from autolyzate as an adsorption complex of phosphate by the use of CaCl_2 and sodium hydrogen phosphate. The precipitate is freed from excess of salt by washing them thoroughly with water and dried them at low temperature. Instead of CaCl_2 and sodium hydrogen phosphate, the neutral insoluble alkaline earth like bentonite can also be used for precipitating the enzyme. Some manufacturers have also used lead acetate for precipitating the enzyme. The precipitate is separated by filtration or centrifugation. The excess of lead is then removed by the addition of potassium oxalate and the excess of oxalate is finally removed by dialysing the solution. The dialysed enzyme is precipitated with equal volumes of alcohol and dried at low temperature.

Packing of enzymes. The dried enzyme powder is stabilized by addition of solid organic acid and packed in air tight bottles and stored in a cool place.

Preparation of ragi malt

E (IS) 20875 (365)

I shall be much obliged if you can kindly inform me the particulars regarding the preparation of ragi malt. (Tanjore Dist.)

Select good ragi seed which has a germination capacity of 98 per cent or more. The grains are cleaned well with water and then steeped in water for 24 hours. While steeping, the water should either be flowing continuously or be

renewed every 4 hours. The steep water is drained out after the steeping period and the soaked grains are spread on a wet gunny cloth, covered with wet gunny and left in a dark, cool room. The thickness of the spread grains should not be more than 3-4". Once in every 24 hours, the grains are heaped up, some water sprinkled on it and spread again. The germination of the seeds is allowed to proceed in this way for 72 hours. After this period, the grains will have developed a radicle of about $\frac{1}{2}$ ", when they are spread in the sun and dried. The vegetative portion (both the stock and the root) is then removed by rubbing the grain on a gunny sack or a wire mesh. The grains are winnowed free from the vegetative portion and slightly roasted in an open pan preferably at a temperature of about 70°C . The roasted grains are powdered, and sieved in a fine mesh sieve (60 to 80 mesh per inch). The powder is finally stored in tins or bottles.

Adulteration of milk

E (IS) 1871 (366)

Let me know why the lactometer is not helpful sometimes in detecting the dilution of milk with water. Is there any other instrument that can be used for detecting adulteration in milk? What is the method of estimating the amount of cream in separated milk? (Moradabad).

Lactometer is an instrument which can only give the sp. gravity of milk. As such, if milk has been diluted with water alone, it should be possible to detect this dilution with the lactometer. However, if the lowering of the sp. gravity of milk due to addition of water is made up by adding extraneous solids, then the instrument

fails. In such a case, there are other chemical methods by which adulteration in milk can be detected. The amount of fat in the milk can be determined by the Babcock test which is carried out as follows:

Concentrated sulphuric acid is added to milk taken in a Babcock milk test bottle and shaken vigorously for about one minute after the uniform dark colour is noticed. The bottle is placed in a centrifuge either motor driven or hand-operated and whirled for 5 minutes. The fat separates and rises to the surface. The reading of the fat layer is directly read from the scale given on the neck of the bottle which gives the percentage of fat by weight in milk.

The apparatus required for the above test are (1) Babcock test bottle, (2) a pipette calibrated to hold 17.6 c.c. at 68°F (20°C), (3) an acid measure graduated to 17.5 c.c. and (4) a centrifuge. In addition, sample bottles for collecting milk, a mixing jar, thermometer and a pair of dividers for taking the reading are required. The details of the above method can be found in any of the text books on Dairy products.

The fat percentage determined as above should conform with the range fixed for cow's or buffalo's milk according to Indian Food Laws. This will be a very good indication of the purity of milk. The apparatus required can be obtained from any of the firms dealing with scientific instruments like:

1. Scientific instrument Co., Ltd. 30 Mount Road, Madras.

2. Scientific Instrument Co., Ltd., Navasari Building, 240, Hornby Road, Bombay-1.

The quantity of cream in skim (separated) milk is determined by the Babcock test.

Notes and News

STATISTICAL NOTES

Food Production Statistics for January and February, 1957

| Name of Industry | | | No. of Units | Production during January 1957 | No. of Units | Production during February 1957 |
|----------------------------|-----|-----|--------------|--------------------------------|--------------|---------------------------------|
| Confectionery | ... | ... | 32 | 728 tons | 27 | 586 tons |
| Biscuits | ... | ... | 25 | 946 " | 25 | 982 " |
| Flour Milling | ... | ... | 33 | 40,500 " | 30 | 44,755 " |
| Oil Milling | ... | ... | 135 | 50,082 " | 125 | 51,315 " |
| Butter (Tinned) | ... | ... | 3 | 75 " | 3 | 35 " |
| Cashewnuts | ... | ... | 15 | 616 " | 9 | 482 " |
| Dal and Gram flour | ... | ... | 4 | 1,043 " | 1 | 333 " |
| Aerated Water | ... | ... | 30 | 29,877 gross bottles | 28 | 32,349 gross bottles |
| Beer | ... | ... | 2 | 36,020 B. gals. | 2 | 48,307 B. gals. |
| Country Spirit | ... | ... | 27 | 344,651 " | 27 | 415,803 " |
| Indian made Foreign Liquor | ... | ... | 17 | 46,661 " | 17 | 49,174 " |

(Ministry of Commerce and Industry, Government of India.)



Sri K. C. George, Food Minister, Kerala State and Dr. M. S. Thacker, Director-General, Scientific and Industrial Research who discussed the popularization of tapioca macaroni rice in Kerala State with the Director and staff of C.F.T.R.I.

C.F.T.R.I. NEWS

Visitors

The following distinguished persons visited the Institute during April and May, 1957.

17-4-57. Mr Little John, Dr Andrews and Mr Angers of M/s Metal Box Co., of India, Calcutta.

18-4-57. Members of the Indian Central Arecanut Committee:

Prof. T. R. Seshadri, Head of the Department of Chemistry, Delhi University; *Prof. M. O. Farooq*, Head of the Department of Chemistry, Muslim University, Aligarh; *Dr Y. Nayudamma*, Asst. Director-in-Charge, Central Leather Research Institute, Madras; *Dr H. K. Baruah*, Head of the Department of Botany, Gauhati University, Assam; *Shri M. K. Krishna Chetty*, M/s Asoka Betelnut Factory, Coimbatore; and *Shri B. S. Varadarajan*, Secretary, Indian Central Arecanut Committee, Kozhikode.

22-4-57. Dr A. S. Outschwom, Medical Research Institute, Colombo.

27-4-57. Dr L. A. Dean, Soil Science Adviser, T.C.M. He also addressed a special Seminar on 'Use of Radio-isotopes in Agricultural Research.'

4-5-57. Dr S. D. Mahant, Secretary, National Research Development Corporation and Regional Liaison Officer, New Delhi. He also addressed a Seminar on 'Scientific Research and Commercial Development.'

12-5-57. Prof. M. S. Thacker, Director-General, Scientific and Industrial Research, Shri P. M. Sundaram, Secretary, Council of Scientific and Industrial Research, Shri K. C. George, Minister for Food and Shri C. Thomas, Secretary, Department of Agriculture, Kerala State.

15-5-57. Mr Francis, Chief Engineer, Marine Department, Bombay.

All-India Final Estimate of Rice, Maize and Ragi 1956-57

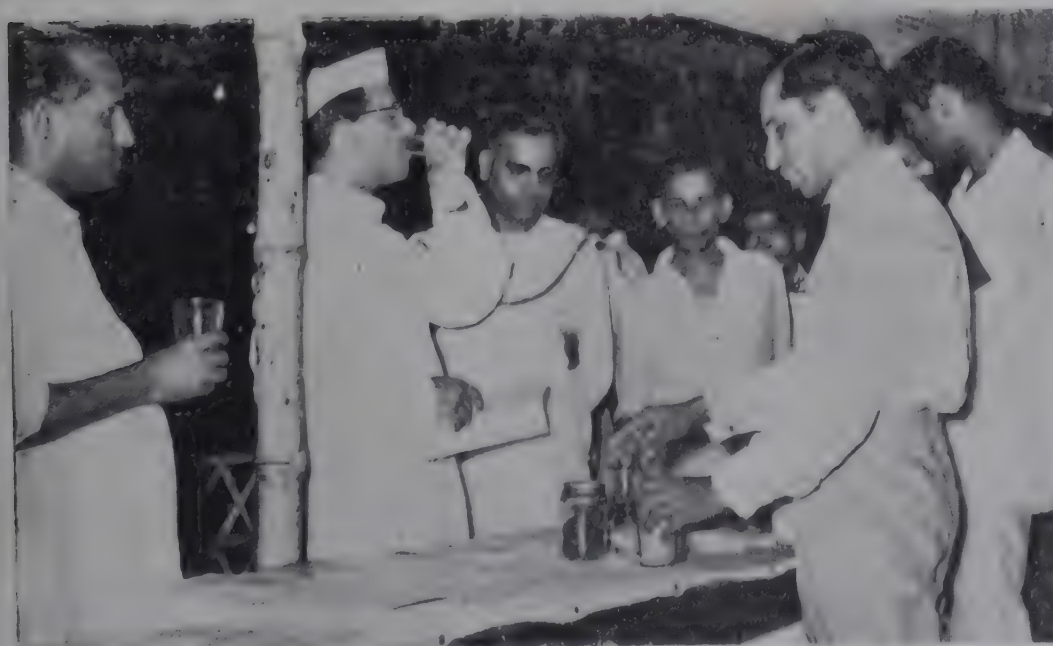
| Crop | Area (thousand acres) | | Production (thousand tons) | |
|-----------|-----------------------------|---|-----------------------------|---|
| | 1956-57 (Final Estimate) | 1955-56 (Partially Revised Estimate) | 1956-57 (Final Estimate) | 1955-56 (Partially Revised Estimate) |
| Rice ... | 78,174 | 76,864 | 28,142 | 26,846 |
| Maize ... | 9,244 | 9,116 | 3,020 | 2,554 |
| Ragi ... | 5,674 | 5,693 | 1,914 | 1,820 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)



(Top) A view of the Institute stall at the All-India Khadi and Village Industries Exhibition, Kaladi.

(Bottom) Shri Shriman Narayan, General Secretary of the A.I.C.C. tasting some of the products at the stall.



17-5-57. Dr N. Ramasharma, Southern Railway, Mysore.

18-5-57. Mr Ram Gavala, Director, Films Division, Bombay and party.

Mr Mehta and 61 Foreign Students of the Summer Camp.

Appointments and Postings

Assistant Research Officer

Dr R. Radhakrishnamurthy.

Junior Scientific Assistants

Mr P. S. Balakrishnan.

Mr M. V. Sharangapani.

Nomination: Dr V. Subrahmanyam has been nominated as representative of the Council of Scientific and Industrial Research on the Science sub-commission of the Indian National Commission for co-operation with UNESCO for a period of three years.

Demonstration of Macaroni Products

The Institute held a special demonstration on the use of tapioca macaroni products on the 23rd and 24th May, 1957 at the Secretariat Buildings, Trivandrum. Mr E. M. S. Nambudripad, Chief Minister of Kerala, Secretaries to the Kerala Govt. and other high officials were present on the occasion. Dr V. Subrahmanyam, Director of the Institute gave a talk on the efforts made to popularise the use of tapioca macaroni products which was greatly appreciated.

Participation in Exhibition

The Institute participated in the All-India Khadi and Village Industries Exhibition held in Kaladi, Kerala State from the 4th to the 13th of May, 1957, cynchronising with the 9th All-India Sarvodaya Sammelan. A special demonstration of the method of preparation and preservation of fruit and vegetable products on home and cottage scales was conducted. The utilisation of the Indian Multipurpose Food in various sweet and savoury preparations and the use of tapioca macaroni products were also demonstrated to the visitors. The Institute stall attracted a large number of visitors every day.

I.S.I. Announcement

The Government of India has decided to introduce metric system as the only system of weights and measures for the country within a period of ten years. During this interval when the changeover to the metric system takes place, there will be a great need for a useful reference book for conversion of values from the existing system of units to metric system. The decision of the Government of India to decimalize the monetary system used in the country, which has now been implemented, would also require a reference book for conversion of monetary values from the existing system to decimal units. To meet these needs, the I.S.I. has published the Indian Standard Conversion Factors and Conversion Tables (IS:786-1956).

The Standard contains 154 tables covering inter-conversion of values on the following subjects:

BASIC UNITS, MONEY, LENGTH, AREA, VOLUME AND CAPACITY, WEIGHT, TEMPERATURE, ANGLE, SPEED, DENSITY AND CONCENTRATION, STRESS AND PRESSURE, TRANSPORT, FORCE, ENERGY, POWER AND HEAT.

This standard has been compiled with the specific object of assisting the trade and industry, Government departments, engineers technologists, scientists, students and others interested in quick and accurate inter-conversion of values.

The Standard is priced Rs 5 and can be had from the Indian Standards Institution, 19, University Road, Delhi.

List of Papers Published

601. **Supplementary value of fresh jack fruit with or without**

honey to poor rice diet, by Siddappa, G. S. and Bhatia, B. S., *Ann. Biochem. exptl. Med.*, 1957, **17**, 1.

602. **Supplementary value of orange juice powder to poor rice diet**, by Siddappa, G. S. and Bhatia, B. S., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 15.

603. **Adulteration of coffee and its detection**, by Subrahmanyam, V., Bhatia, D.S. and Natarajan, C.P., *Indian Coffee*, 1957, **21**, 8.

604. **The enzymes of pearl millet (*Pennisetum typhoideum*) malt: Part I—Analysis**, by Chandrasekhara, M. R. and Swaminathan, M., *J. sci. industr. Res.*, 1957, **16C** (2), 35.

605. **Effect of drying of rice bran on oil extraction by ethyl alcohol**, by Krishnamurthy, R. G., and Rao, Y. K. R. *Food Sci.*, 1957, **6** (3), 47.

606. **Drying of eggs**, Digested from John doe Publications (1956), *Food Sci.*, 1957, **6** (3), 49.

607. **Production of Infant Food and other products from buffalo milk in India**, by Subrahmanyam, V., Chandrasekhara, M.R. Bhatia, D.S. and Swaminathan, M., *Food Sci.*, 1957, **6** (3), 52.

608. **Studies on tannin-like constituents in coffee**, by Natarajan, C.P., Iyengar, J.R. and Bhatia, D.S., *J. sci. industr. Res.*, 1957, **16C**, (2), 42.

609. **Soluble Coffee**, by Natarajan, C.P. and Bhatia, D.S., *Indian Coffee*, 1957, **21**, 110.

610. **Studies on the starch synthesizing enzymes in tapioca (*Manihot utilissima*) roots**, by Murthy, H.B.N., Rama Rao, G., and Swaminathan, M., *Enzymologia*, 1957, **18** (1), 63.

Additions to the Library

1. *Planned diet for India*, 1946, By PATTANAYAK, G. C., (Kitabistan. Allahabad), pp. 90. Rs 3-12-0.

2. *Symposium on scientific principles and their application in tropical building design and construction*, Bulletin No. 6, 1955, By NATIONAL INSTITUTE OF SCIENCE OF INDIA, pp. 392, Rs 36-4-0.

3. *Pest infestation research*, 1955, By DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, LONDON, (H.M.S.O.), pp. 62, £0-3-0.

4. *Paper and paper products and shipping containers*, 1955. By AMERICAN SOCIETY FOR TESTING MATERIALS, pp. 394, \$4.25.

5. *Industrial electronics*, 1948, By WESTING HOUSE ELECTRIC CORPORATION, U.S.A., pp. 680, Rs 70-0-0.

6. *Engineering economics for Indian students*, 1956, By NANDI, S. K., (Chatterjee and Co. Cal), pp. 218, Rs 8-0-0.

7. *Recent advances in the chemistry of colouring matters*, Symposium, 1956, By ELVIDGE, J. A., (Chemical, Soc. Lond.), pp. 87, £0-15-0.

8. *Technique of organic chemistry*, Vol. 9, 1956, By WEISSBERGER, A., (Interscience), pp. 787, \$15.00.

9. *Law of food adulteration*, 1956, By MALIK, M.A., (Jaina and Bros. Delhi), pp. 88. Rs 4-0-0.

10. *Animal husbandry and dairying*, 1956, By SUBBIAH MUDALIAR, V. T., (Bangalore Press), pp. 228. Rs 8-12-0.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

A new paper chromatographic method for the estimation of histidine, by Bhattacharya, K. R., Datta, J. and Roy, D. K., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 1.—Earlier workers had described a method for the estimation of histidine on paper chromatograms based on the pauly diazo reaction involving measurement of the maximum colour density of the spot by a photoelectric densitometer and measurement of the spot area by a planimeter. The AA have described in this paper a simpler method of eluting the colour in a suitable solvent and then estimating it with a photoelectric colorimeter. The chromatograms are dried in air for about an hour after the development of the coloured spots. The spots are then cut out, made into small pieces and eluted with 5 c.c. portions of 1 per cent Na_2CO_3 solution in test tube with occasional shaking for exactly 15 minutes. The solutions are then transferred into colorimetric tubes, allowed to stand for 1 minute to facilitate filter paper fibres to settle down and the reading was taken in the Klett Summerson photoelectric colorimeter with 540 $\text{m}\mu$ filter using the blank colour for setting the 100 per cent transmission. The amount of histidine corresponding to the reading observed can be read from the standard curve obtained first by using known amount of histidine and measuring the colour produced. The method is fairly accurate within ± 5 per cent. The above procedure simultaneously helps to detect qualitatively the presence of tyrosine.

K.L.R.

BIOCHEMISTRY AND NUTRITION

Interdependence of thiamin and ascorbic acid: Effect of ascorbic acid supplementation to thiamin deficient rats, by Bhattacharya, K. R., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 5.—The inter-relations between the vitamins of the B. group and ascorbic acid has been demonstrated by many earlier workers. In the case of a rat with B-vitamin deficiency, there would be a dual deficiency of the B-vitamin deficiency, in question as well as ascorbic acid. The A. reports in this paper the effect of supplementing ascorbic acid in the diet of rats deficient in thiamin. The results show that supplementation of ascorbic acid has no significant effect on the blood pyruvic level in thiamin-deficient rats. The tissue reserve of ascorbic acid in thiamin-deficient rats is decreased as compared to a higher value observed in thiamin-deficient but ascorbic acid supplemented rats. It is also seen that the average survival period of thiamin-deficient rats was 7 weeks while that of thiamin-deficient but ascorbic acid-supplemented rats was 8.3 weeks. The former group showed a small net loss in body weight at the end of 6 weeks while those of the latter gained weight. Further the physical appearance and well being was much better in the latter group of rats. These findings indicate that the thiamin-deficient but ascorbic acid-supplemented rats were suffering from thiamin-deficiency only while the unsupplemented thiamin-deficient rats suffered from a double deficiency of thiamin and ascorbic acid. This shows that there is a definite

interdependence between ascorbic acid and thiamin. K.L.R.

Supplementary value of orange juice powder to poor rice diet, by Siddappa, G. S. and Bhatia B. S., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 15.—The AA have studied the supplementary value of orange juice powder to poor rice diet by feeding trials on young albino rats for 8 weeks. Coorg and Sathgudi orange juice, juice powder and ash from juice powder have been used in the diet compositions and the average weekly growth rate and food intake have been recorded. The results show that there is no significant difference either in the gain in weight or food intake among the diets as compared to the control diet. The animals maintained normal health during the whole of the experimental period. The investigation shows that the beneficial value of orange juice should therefore be ascertained by factors other than mere growth.

K.L.R.

Studies on rat liver histidase by Sivaramakrishnan, V. M. and Sarma P. S., *J. sci. industr. Res.*, 1957, **16C** (4), 74.—*p*-Chloromercuri-benzoate and iodoacetate inhibit histidase activity of rat liver. Glutathione largely overcomes the inhibitory effect of *p*-chloromercuribenzoate. The results suggest that rat liver histidase is a sulfhydryl enzyme.

The site of action of *p*-chloromercuribenzoate in the degradation sequence of histidine has been found to be between histidine and urocanic acid.

Stability of vitamin B_{12} in proteolysed liver extract, by, Sreenivasamurthy, V., Swamina-

than, M. and Subrahmanyam, V., *J. sci. industr. Res.*, 1957, **16C**, (4), 83.—The vitamin B₁₂ potency of proteolysed liver extracts deteriorates on storage, the loss being about 87 per cent in samples stored for 6 months. Light converts cyanocobalamin to hydroxocobalamin which in the presence of air gradually loses its vitamin activity. The vitamin remains stable when stored in a completely filled sealed bottle or in bottles sealed after evacuation or after filling with an inert gas.

DAIRY

A study of variations in butterfat content of bulked milk from Haryana cows, by Ahuja, L.D. and Gautam, A. N., *Indian J. Dairy Sci.*, 1956, **9**, 109.—Nearly 996 morning and 993 evening milk samples obtained from the Haryana breed of cattle during the years 1952 to 1954 were analysed for their butterfat content. The evening milk (average 5.11 ± 0.33 per cent) was always richer than the morning milk (average 4.62 ± 0.16 per cent), and the difference was statistically significant. The effect of season was also apparent. The butterfat content was high and low in the months of December and May respectively. Rainfall depressed butterfat content of milk.

Hydrogen-ion concentration of milk. Part II. Effect of some factors on the pH of milk, by Bhimasena Rao, M. and Dastur, N. N., *Indian J. Dairy Sci.*, 1956, **9**, 114.—Examination of milk of 9 individual animals beginning from the day of parturition showed that colostrum had low pH and high acidity. The value for pH in the first drawn milk varied from 5.37 to 6.48 in the case of cows and from 6.40 to 6.49 in the case of buffaloes. From the third day onwards the pH steadily increased. The averages for 15 days colostrum period was: Cross-bred cows 6.55, Sindhi cows 6.32 and Murrah buffaloes 6.49.

On the same day, the morning and evening milk samples did not reveal any characteristic difference either in the pH or acidity.

After about the first 20 days of lactation, when the pH steadily rose towards the average, there was no noticeable change in the pH for the remaining period of lactation, though day-to-day fluctuations were common. The secretion obtained after the animals had become 'dry' showed higher pH than the normal.

Examination of ass, goat, human and sheep milk, besides cow and buffalo, showed that milk from different species varied in pH. The average pH of goat, sheep, ass and human milk were 6.54, 6.54, 6.97 and 7.27 respectively.

Skimming in most cases increased the pH of milk slightly.

Dilution with water increased the pH. The increase was 0.01 unit with 5 per cent, 0.04 with 15 per cent and 0.08 with 25 per cent water.

Pasteurisation and boiling increased the pH by 0.04 units. Sterilised milk showed an average decrease of 0.18 units.

Riboflavin content of buffalo milk curds, by Boman, T. J. and (Miss) Usha Dalal, C., *Indian J. Dairy Sci.*, 1956, **9**, 131.—Using the *L. casei* as the test organism in the microbiological assay of riboflavin from buffalo milk curds, it was found that the riboflavin content was from 1.0 to 1.66 $\mu\text{g./g.}$ of curds. Stimulation of this test culture by fat was found in the experiments carried out on the curds prepared from buffalo whole milk.

Colour development of Desi ghee, by (Miss) Lalitha, K.R. and Dastur, N.N., *Indian J. Dairy Sci.*, 1956, **9**, 143.—Butterfat in samples of milk or cream stored for some time developed a greenish yellow colour. The colour was not observed when sterilized milk samples, or cream containing over 40 per cent fat, were used. Colour development reached a maximum in about 2 hours in raw samples.

The colour intensity in butter fat varied in the milk of different animals, as well as in morning and evening milk.

In soured milk the fat in top layer was coloured least, while that from the bottom layer gave the highest colour.

The colour development in butterfat was influenced by micro-organisms but amongst the common micro-organisms occurring in milk none showed any difference in influencing the colour development. The colour developed was not carotenoid in nature.

Colour development did not occur in aseptically collected milk samples unless a starter was added.

It is postulated that the colour is formed in milk by micro-organisms acting on some unidentified constituent of milk and is absorbed by butterfat present.

Tables for S.N.F. of buffalo milk, by Limdi, B. C. and Bhatt, S. S., *Curr. Sci.*, 1957, **26** (4), 113.—The solids-not-fat of buffalo milk can be determined by applying Richmond's formula. In order to avoid the waste of time taken in the calculations, the AA have prepared a table based on the above formula, which has been presented in this note. The S.N.F. of buffalo milk can be directly read from the table once the lactometer reading at 60°F and the fat percentage in the milk are known. The reading obtained from the table is fairly accurate.

K.L.R.

MICROBIOLOGY

Antibiotic studies on Indian soil micro-organisms: Part IV *Streptomyces caiusiae*—A new antibiotic—producing species of streptomyces, by Dhala, S. A., Poonawalla, F. M. and Bhatnagar, S. S., *J. sci. industr. Res.*, 1957, **16C** (4), 76.—A new species of *Streptomyces* possessing antibacterial and antifungal activity has been isolated from a soil sample collected at Madras. It has been designated as *Streptomyces caiusiae* sp. n. Its morphological characteristics and physiological behaviour have been studied in detail. It has thus been found to belong to the chromogenic *Sterptomyces antibioticus* group of soil actinomycetes. Its similarity and differences to a few known species are discussed.

OILS AND FATS

Hyderabad earths for bleaching vegetable oils: Part II, by Joshi, S. S., Saletore, S. A. and Zaheer, S. H., *J. sci. industr. Res.*, 1957, **16A** (4) 179.—Fullers' earth occurs extensively at Krovi, Chime-idlai, Dastapur and Sulepeth (Chineholi taluk, Gulbarga district, Mysore State). Earths from these places when activated with hydrochloric and sulphuric acids have adsorption characteristics comparable to those of commercial samples. Korvi and Chime-idlai deposits, being fairly free from girt, sand and acid-soluble impurities, can be commercially exploited.

Stabilization of edible fats by spices: Part III, by Sethi S. C. and Aggarwal J. S., *J. sci. industr. Res.* 1957, **16A** (4), 181.—The antioxidant action of turmeric, dried ginger, cinnamon leaves, onions and a few other spices has been studied on refined lard. A yellow solid material isolated from

onion possessed the maximum activity which is, however, much lower than that of hydroxychavicol, isolated from betel leaves.

GENERAL

Investigations on the utilization of byproducts of arecanut (*Areca catechu* Linn): Part I. Biochemistry of the husk, by Baruah, H. K., Raghavan, V. and Murthy, K. N., *J. sci. industr. Res.*, 1957, **16C**, (4), 89.—The principal constituents of the cell wall material of arecanut husk are pectin, protopectin, hemicellulose, cellulose and lignin. The proportions in which they are present vary with the maturity of the husk.

Experimental trials on the rapid softening of husk and the separation of fibres show that pectinolytic bacteria are more effective than hydrolytic agents like ammonium ozalate and sodium phosphate. Methods have been described for the preparation of hard boards from arecanut husk fibres.

PART II (Foreign)

ANALYTICAL

Hemicellulose components of rice, by Bevenue, A. and Kenneth, T. W., *J. agric. Fd. Chem.*, 1956, **4** (12), 1014.—In the first systematic study of hemicelluloses of rice bran, rice polish, and polished rice, these fractions were quantitatively determined and the isolated polysaccharides were examined by paper chromatography. Rice grain hemicelluloses are composed briefly of arabinose and xylose in a ratio of approximately 1 to 1, and contain small quantities of galactose, mannose, and uronic acid. These data provide basic information for use in the production, processing, and utilization of rice.

Determination of Captan, by Wagner, J., Wallace, V. and Lawrence, J. M., *J. agric. Fd. Chem.*, 1956, **4** (12), 1035.—A specific and sensitive analytical method for the fungicide, captan, N-(trichloromethyl-thio) tetrahydrophthalimide is based on the reaction with alkaline resorcinol under reducing condi-

tions. The method is most useful in the range of 3 to 30 γ , and a semiquantitative measure of as little as 0.4 γ is readily obtained. Good recoveries were obtained from various natural products.

BIOCHEMISTRY AND NUTRITION

Essential amino acid composition of pulses and rice, by Kanti Pada Chatterjee, *et al.*, *Food Res.*, 1956, **21** (5), 569.—The ten essential amino acids were estimated in seven varieties of pulses and in parboiled rice microbiologically. Leucine, isoleucine, valine, histidine, lysine and tryptophane are present in highest concentration in the protein of *Phaseolus radiatus*. Phenyl-alanine, methionine, arginine and threonine are present respectively in highest concentrations in *Cajanus indicus*, *Phaseolus mungo*, *Risum sativum* and *Lathyrus sativus*. Rice is rich in tryptophane, methionine, phenylalanine and histidine.

Protection of jute materials against microbiological actinic deterioration: Part II. Evaluation of some proofing agents against weather exposure, by, Macmillan, W. G., Basu, S. N. and Pal, P. N., *J. sci. industr. Res.*, 1957, **16C**, (4), 95.—Various proofing treatments previously found to confer rot-resistance to jute fabrics, as well as certain modifications of these methods, have been tested for efficiency against weathering damage involving both actinic and microbiological deterioration. Weather exposure was found to have a drastic effect on fabric strength, chiefly due to the action of sunlight, against which only cutch and chromium afforded some degree of protection. Copper treatment, although superior to others, proved inadequate against weathering. A comparison has been made of the weathering damage resulting from exposure during wet and dry seasons.

The absorbability of natural and modified fats, by Calloway, D. H. and Kurtz, G. W., *Food Res.*, 1956, **21** (6), 621.—Mature rats were fed a series of natural and modified fats in order to determine the relationships among melting point, saturation, chain length, structure and digestibility. Twenty per cent fat was incorporated into a purified diet fed for two weeks. Feces were collected during the last five days for fat analysis.

Natural fats included in the study were: cottonseed, soyabean, corn, coconut and palm oils, lard and butterfat. Digestibility was not related to the characteristics cited. When these same fats were fully hydrogenated, digestibility varied inversely in linear fashion with the chain length of the constituent fatty acids and in curvilinear fashion with the amount of saturated acids C_{18} and above. The general inverse linear relation between digestibility and melting point is ascribed to the relationship which exists between the melting

point and the amounts of component fatty acids.

The monoglycerides of hydrogenated lard was found to be more digestible than the original triglyceride. Substitution of one-third of the fatty acid radicals by butyryl groups was equally effective in raising digestibility; while simple mixture of tributyrin with hydrogenated lard showed no effect.

Digestibility of mannitol esters of lards was similar to that of the glyceride lards from which they were made, indicating that digestibility was a function of the constituent fatty acids.

It is concluded that digestibility is primarily dependent upon the amounts and chain length of the saturated fatty acids and their arrangement within the glyceride structure.

DAIRY

Control of gelation in evaporated milk, by Tarassuk, N. P. and Tamasma, A. F., *J. agric. Fd. Chem.*, 1956, **4** (12), 1033.—Gelation of evaporated milk in storage can be controlled by preheating milk in the concentrated state, followed by dilution to standard composition, if necessary, and sterilization. This treatment does not affect in colour and flavour of the finished product. The optimum time and temperature of the preheating treatment vary with the concentration of the milk at the time it is preheated. Because of variations in the colloidal characteristics of milk, optimum conditions of the preheating treatment also vary seasonally and with milk from different areas.

FISH

Objective tests applicable to quality studies of ice stored shrimp, by Bailey, M. E., Fieger, E. A. and Novak, A. F., *Food Res.*, 1956, **21** (6), 611.—A general review of chemical, physical and microbiological tests useful for determining the relative quality of ice stored shrimp is given. These tests are compared as indices of quality in relation to organoleptic changes in ice stored shrimp. The

glycogen-sugar and the lactic acid and acid-soluble ortho-phosphate contents can be used for relative comparison of shrimp during their prime quality phase. Other useful tests are: pH, amino nitrogen, degree of hydration of water-insoluble protein, and B-vitamin content. Tests useful for determining onset of spoilage of ice stored shrimp are: trimethylamine nitrogen, volatile acids, bacterial content, sulfhydryl groups determined by iodine titration, and Nessler ammonia.

In most instances, individual tests are not conclusive for objectively qualifying shrimp, but rather are useful as relative quality indices when used in various combinations. However, a trimethylamine nitrogen value of 1.5 mg./100 g. shrimp tissue and a bacterial count of 10×10^{-6} per gram of headless, shell-on shrimp or higher are indicative of unacceptable shrimp in most instances. Tentatively, shrimp having a pH value below 7.7 can be considered as a prime quality, those having pH values between 7.7 and 7.95 as poor but acceptable and those having a pH value above 7.95 either as spoiled or on the borderline of spoilage.

FRUIT AND VEGETABLE PRODUCTS

Antioxidant properties of tomato lipids, by Henze, R. E. and Quackenbush, F. W., *J. Amer. oil Chem. Soc.*, 1957, **34** (1), —Highly active antioxidants for lard were extracted from dried tomato fruits with petroleum ether. When added to fresh lard, the tomato lipids protected against autooxidation at 100°C. for long periods with little accumulation of peroxides during the induction period. When added at a 2 per cent level to actively oxidizing lard (peroxide values 20 to 130), the tomato lipids effected a rapid drop of approximately 25 per cent in titrable peroxides. When added at a level of 8 per cent, this immediate drop was followed by a second, more gradual, drop to a constant low value (*ca.* 5), which was maintained for a long period at 100°C.

The antioxidant activity of the tomato lipids was separated into two fractions, one consisting of a primary antioxidant and the other of a synergistic (potentiating) substance. The primary antioxidant activity was accountable in the tocopherol content of the extracts. The synergistic activity was qualitatively similar to phosphoric acid, and the synergistic fraction was found to contain 2.4 per cent phosphorus. However solubility data indicated that the phosphorus was present in an organic form, probably phosphatides.

The chemical constituents of victoria plums: Chrysanthemin acid and pectin contents, by Dickinson, D. and Gawler, J. H., *J. Sci. Fd. Agric.*, 1956, **7**, 699.—Analytical methods have been evolved for the determination of chrysanthemin and of malic acid in the fruit. The chrysanthemin, malic acid and pectin content of bottled victoria plums have been measured and compared with the corrosivity of similar canned samples. It has been shown that the corrosivity of the juice as measured by practical canning trials, is related inversely to the anthocyanin and malic acid contents. The pectin content—within the limits of natural concentration—has been found to have no influence on the velocity of corrosion process. A method for separating the acid constituent by means of ion-exchange resins has proved unreliable for quantitative work. Orthophosphoric acid and three chlorogenic acids have been detected in victoria plums.

S.R.

On the structure of 'Hydroxy- α -Carotene' from orange juice, by Curl, A. L., *Food Res.*, 1956, **21** (6), 689.—Using counter-current distribution and chromatography, the author furnishes further information on 'Hydroxy- α -carotene' from Valencia Orange juice. The 'Hydroxy- α -carotene' isolated from orange juice has the probable structure 3-hydroxy- α -carotene in which the hydroxyl group is on the β -ionone ring. It is further stated

that a substance with this assumed structure would not be a provitamin A, because carotenoids having an unsubstituted β -ionone at one or both ends of the molecule have vitamin A activity; the α -ionone ring and 3-hydroxy β -ionone ring are both inactive. J.S.P.

Influence of vining on the development of off-flavour in frozen peas, by Lee, F. A., *et al.*, *Food Res.*, 1956, **21** (6), 666.—The study covers a comparison involving the chemical and organoleptic differences in unblanched peas (I) vined previous to storage at -17.8°C and those stored in the pods (II). The peroxide values of the extracted crude lipids obtained from peas (II) stored longer than 62 days were considerably higher than those found in the crude lipids extracted from peas (I). Likewise total sugars, reducing sugars and sucrose were higher in II than in I. Greater chlorophyll degradation took place in II than in I. Suggestions have been made as to possible causes of these phenomena.

Peas stored at -17.8°C unblanched in the pods retained reasonably good eating quality for a little over a month. After this period, gradual deterioration became apparent. Unblanched vined peas started to decline in quality after about a week of storage. J.S.P.

Action of lipoxidase in frozen raw peas, by Wagenknecht, A. C. and Lee, F. A., *Food Res.*, 1956, **21** (6), 605.—The AA report the presence of lipoxidase in frozen raw peas, its partial purification and its action in bringing out the peroxidation of pea lipids and the destruction of chlorophyll in blanched peas. The reactions through which lipoxidase may contribute to off-flavour formation and other changes in quality of frozen raw peas have been demonstrated. J.S.P.

The onion: Gaseous emanation products, by Niegisch, W. D. and Stahl, W. H., *Food Res.*, 1956, **21** (6), 657.—The AA report on the gas partition chromatographic, mass

spectrometric and infrared spectroscopic analyses of onion vapours trapped at various low temperatures in the absence of air. The relative concentration of each component present are tabulated. The major point of interest to note is that no evidence of the existence of allyl propyl disulphide reported by other investigators was found despite the great care taken in processing samples and searching for this compound. J.S.P.

The role of dehydroascorbic and dehydroreductic acid in the browning reaction, by Dulkan, S. I., and Friedemann, T. E., *Food Res.*, 1956, **21** (5), 519.—An attempt has been made to elucidate the role of ascorbic acid (ASA) and reductic acid (RA) in the browning reaction. Both ASA and RA undergo a type of browning reaction analogous to that occurring in heat processed and stored foods, i.e., accompanied by marked increases in colour, fluorescence, reducing properties and acidity. Oxidation of these compounds to the dehydro form is a prerequisite to browning, and is characterized by simultaneous oxidation-reduction reactions. J.S.P.

Bacteriological flora in frozen and chilled orange juices, by Purko, M. *et al.*, *Food Res.*, 1956, **21** (5), 583.—Data pertaining to certain types of coliforms and related organisms in orange juice are presented. Isolation of Gram negative rods from orange juice was accomplished by a direct plating method using Violet Red Bile agar, a selective medium for coliforms. All samples were adjusted to pH 6.5 with sterile NaOH solution prior to plating. Incubation was at 37°C for 18 hours.

When the 150 isolates were grouped according to their IMVIC pattern, 65 per cent were of the *Aerobacter* type and 35 per cent were of the intermediate type. No cultures of the *Escherichia coli* type were isolated. Identification studies of 17 cultures isolated from one sample of orange juice revealed that five cultures closely resembled

Aerobacter aerogenes; four, *Escherichia freundii*, two, *Escherichia intermedium* and one, *Serratia marcescens*. The remaining five cultures resembled organisms of the genus *Erwinia*.

J.S.P.

Effect of 2, 4, 5-trichlorophenoxyacetic acid spray on organic acids, pectin and quality of canned apricots, by Hoos, J. W., *et al.*, *Food Res.*, 1956, **21** (5), 571.—The study deals with the quality of sprayed and control apricots canned at different stages of maturity. Changes occurring during maturation in organic acids, pectin and other constituents that are related to flavour, texture and quality of the canned products are reported.

Results indicate that malic acid is the dominant organic acid, although smaller amounts of citric acid are also present. Both malic and citric acid contents decrease (as the fruit matures) more rapidly in sprayed than in control samples. Enhanced apricot growth by 2, 4, 5-T has been attributed to the faster rate of metabolism of malic and citric acids in the fruit.

Conversion of protopectin to water-soluble pectin is responsible for softening of the apricot during maturation. Use of sugar acid ratio and pressure test as objective criteria for maturity is discussed. Among the samples tested, a pressure test of 1.4 lb. immediately before canning was considered as optimum maturity. With proper control of concentration and time of application as well as time of harvest, spraying with 2, 4, 5-T could yield a canned product near or equivalent to the quality of an unsprayed sample.

Colour co-ordinates of canned apricot samples were determined with a three-filter reflectance colorimeter and the results correlated with visual colour grading. The influence of 2, 4, 5-T spray and maturity of the fresh fruit on flavour, colour, texture and syrup viscosity of the canned product is presented.

J.S.P.

The evaluation of processing times for raw-pack canning of some low-acid vegetables at home, by Cover, S. *et al.*, *Food Res.*, 1956, **21** (4), 405.—Process times at 240°F estimated to yield process values that are equivalent to or greater than the suggested process requirements for raw packed vegetables namely, lima beans, carrots, cream style corn, whole kernel corn, English peas and summer squash are presented and discussed. Heat penetration data from the raw-pack studies have been compared with previously reported data on preheated or blanched packs.

J.S.P.

INSECTICIDES

The toxicity of D.D.T. in abrasive and non-abrasive dusts to the rice weevil, *Calandra oryzae* L. (Coleopt, Curculionidae), by Anne Harlow, P., *Ann. appl. Biol.*, 1957, **45** (1), 90.—The toxicity of DDT in different dust carriers to the rice weevil, *Calandra oryzae* was determined under standardized conditions, using deposits large enough to ensure that the insects accumulated an excess of dust.

Some evidence was obtained that DDT is transported to the cuticle as a vapour.

At high humidity, the toxicity of DDT was not markedly affected by any carrier except charcoal which reduced the toxicity, probably by absorption of DDT vapour. Small differences in toxicity of DDT caused by other carriers could not be accounted for by differences in their average particle size, bulk density, amount adhering to insect, surface area, abrasiveness to insects or effect on behaviour of the insect.

At low humidity, abrasive dusts killed the insects by desiccation, thus adding to the toxic effect of DDT. Abrasion of the insects's cuticle did not affect the apparent

rate of penetration of DDT at 50 per cent R.H. or at 95 per cent R.H.

Starved insects were more susceptible to DDT poisoning, and in some experiments abrasive carriers increased the toxicity of DDT by preventing the insects from feeding.

Investigations on fungicides: II. Aryloxy—and arylthio-alkanecarboxylic acids and their activity as fungicides and systemic fungicides, by Fawcett, C. H.

Spencer, D. M. and Wain, R. L., *Ann. appl. Biol.*, 1957, **45** (1), 158.—A wide range of aryloxyacetic acids and corresponding acids with alkyl groups in the side chain, their arylthio-analogues and the antibiotic griseofulvin have been assessed in the plate test for fungistatic effect on six fungi, and as systemic fungicides against *Botrytis fabae* in broad beans and *Alternaria solani* in tomatoes. The results indicate that in general, arylthio—derivatives are more fungicidal than their aryloxy-analogues. The systemic fungicidal performance of alpha-(2-chlorophenyl-thio) propionic acid in the tomato test at 1-100 p.p.m. was found to be of the same order as that shown by griseofulvin at 50-500 p.p.m. Variable results were obtained with griseofulvin in the tomato test and its performance in the bean test was consistently poor. Further evidence is presented which indicates that the protection conferred by certain compounds may not be due to activity *per se*.

MEAT PRODUCTS

Retardation of poultry spoilage by processing with chlortetracycline, by Broquist, H.P., Kohler, A. R. and Miller, W. H., *J. agric. Fd. Chem.*, 1956, **2** (12), 1030.—When poultry were dipped for 2 hours in a solution containing 1 to 20 p.p.m. of chlortetracycline, bacteriostatic amounts of antibiotic

could be demonstrated in the meat; however, such amounts of antibiotic were not obtained by feeding chlortetracycline in concentrations as high as 1000 p.p.m. to poultry before slaughter. Poultry processed under commercial conditions, with this antibiotic present at 10 to 15 p.p.m. in the chill tanks, keep fresh and edible significantly longer than control birds. The keeping quality of poultry on the verge of spoilage was not improved by dipping in chlortetracycline solutions.

MICROBIOLOGY

The metabolism of yeast sporulation II. Stimulation and inhibition by monosaccharides, by Miller, J. J., *Canad. J. Microbiol.* 1957, **3** (1), 81.—Sporulation and growth of a bakers' yeast isolate were compared in 0.05 to 1 per cent glucose, fructose, mannose, galactose, and dihydroxyacetone. Maximum yields of asci in glucose, fructose, and mannose were observed at 0.05 per cent with a marked decline in increasing concentrations. Maximum yields of three—and four-spored asci were found at 0.1 per cent. Galactose differed from the other hexoses in that the decline in ascus yields at higher concentrations was relatively small. The addition of 0.05 per cent acetate increased the number of spores per ascus in the lowest concentrations of hexose. Cells grown in galactose were somewhat longer than glucose-grown cells, but not when 10^{-1} M phosphate, 3.3×10^{-3} M arsenate, or 0.033 per cent glucose were added to the growth medium. They also formed fewer spores per ascus than glucose-grown cells. Yields of asci in dihydroxyacetone were comparable to those observed in hexose, but growth in this compound was extremely slow. No sporulation or growth was observed in DL-glyceraldehyde, DL-glyceric acid, or glycerol.

ANALYSIS OF FIELD BEANS (*Dolichos lablab*) AT DIFFERENT STAGES OF MATURITY

It has been reported that the ingestion of the seeds of tender field beans (*Dolichos lablab*) brought down blood sugar in hyperglycemic cases, while the mature seeds had no such effect¹. In order to determine whether the difference in these effects was due to a difference in content in the constituents, it became necessary to have a complete analysis of the field bean at different stages of its maturity. Data thereby obtained on the proximate principles of the materials are reported here.

Seeds obtained from freshly harvested field beans were grouped on the basis of colour as tender (green) or more mature (greenish yellow). The seeds thus separated were dried (60°C) and powdered to 60 mesh⁺. Similarly a sample of fully mature and dry beans was obtained from the market, cleaned and also powdered to 60 mesh⁺. Total nitrogen, fat (ether extractives), mineral matter, fibre, calcium, phosphorus and iron were determined

on the dry material in each case. Moisture, thiamine, starch and non-protein nitrogen were determined in the fresh material. Nitrogen was determined by the micro-Kjeldahl method, moisture, mineral matter, fibre, starch and calcium were determined according to the methods of A.O.A.C.² Phosphorus and iron were determined by the methods of Fiske and Subba Row³ and Farrar⁴ respectively. Thiamine was determined according to the method of Swaminathan⁵. Non-protein nitrogen was determined as under:

In the case of the tender and slightly mature seeds, 5 g. fresh material after maceration with a pinch of glass powder was extracted with 50 ml. of trichloroacetic acid (10 per cent) for one hour with occasional shaking. The contents were centrifuged and nitrogen determined in an aliquot of the supernatant solution by the micro-Kjeldahl method. In the case of fully mature sample, non-protein nitrogen was determined by extracting 10 g. of the powdered material with 100 ml. of trichloroacetic acid for one hour with occasional shaking, and nitrogen determined as stated above.

From the results in Table I, it is seen that while the non-protein nitrogen, carbohydrates other than starch (by difference) and thiamine contents of the field bean decrease with maturity, starch content increases, the total nitrogen remaining practically the same.

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TABLE I. *Proximate principles of field beans at different stages of maturity*

| Constituents | Tender beans | | Mature beans | | Fully mature beans | |
|------------------------------|-----------------|------------------------|-----------------|------------------------|--------------------|------------------------|
| | On fresh weight | On moisture free basis | On fresh weight | On moisture free basis | On fresh weight | On moisture free basis |
| Proximate Principles | | | | | | |
| Moisture % | 68.4 | | 55.4 | | 10.9 | |
| Total N % | 1.3 | 4.3 | 1.8 | 4.0 | 3.5 | 3.9 |
| N.P.N. % | 0.4 | 1.2 | 0.2 | 0.4 | 0.4 | 0.5 |
| Total N—N.P.N.=Protein N % | 0.9 | 3.1 | 1.6 | 3.6 | 3.1 | 3.4 |
| Crude protein (N×6.25) % | 5.6 | 19.4 | 6.8 | 22.5 | 19.4 | 21.3 |
| Fat (ether extractives) % | 0.1 | 0.3 | 0.1 | 0.2 | 1.6 | 1.8 |
| Mineral matter % | 1.3 | 4.1 | 1.7 | 3.8 | 3.9 | 4.4 |
| Fibre % | 3.0 | 9.5 | 4.3 | 9.7 | 10.2 | 11.4 |
| Starch % | 12.2 | 38.6 | 21.2 | 47.5 | 41.0 | 46.0 |
| Total | 90.6 | 71.9 | 89.5 | 83.7 | 87.0 | 84.9 |
| Other carbohydrates by diff. | 9.4 | 28.1 | 10.5 | 16.3 | 13.0 | 15.1 |
| Mineral Constituents | | | | | | |
| Ca mg % | 30 | 95 | 40 | 90 | 70 | 78 |
| P mg % | 190 | 601 | 160 | 360 | 550 | 617 |
| Iron mg % | 2.8 | 8.9 | 4.7 | 10.5 | 8.0 | 9.0 |
| Thiamine mg % | 0.6 | 2.0 | 0.5 | 1.1 | 0.5 | 0.6 |

WATER-EXTRACTABLE NITROGEN IN INDIAN PULSES

Pulses occupy an important place in Indian dietaries. One of the chief modes of use of these pulses especially in South India is in the form of the familiar 'Rasam' and 'Sambar'. 'Rasam' is essentially a water extract of the cooked pulse suitably spiced with tamarind, curry powder and salt. The purpose of this investigation was to find out the percentage of total nitrogen that comes into the extract under the conditions followed in the preparation of 'Rasam' using various pulses and to apportion it between protein and non-protein.

The addition of tamarind affects the pH of the extract which in turn may partially render part of the pulse protein in the water extract insoluble. The effect of salt is, however, in the reverse direction i.e. of increasing the solubility. Hence the effect of inclusion of tamarind and salt on the solubility of the pulse protein in making 'Rasam' has been studied in ten varieties of pulses that are commonly used.

Experimental

To three beakers each containing 100 ml. of boiling water were added 10 g. of the pulse

and the boiling was continued till the pulse became soft (as judged by pressing between the fingers). Thus there were 3 samples for each pulse. The first beaker was now cooled under running water. To the second beaker were added 2 g. of tamarind and 2 g. of common salt and the boiling continued for another 15 minutes. The sample in the third beaker served as a control for the second one. At the end of this period, these two beakers were cooled as before. In all the cases, care was taken to see that the volume was maintained constant by addition of hot water upto the original mark. The material from each beaker was then centrifuged, the residue washed twice with water and added to the supernatant solution which was then made up to a known volume. Total nitrogen in the supernatant solution and the original material was determined by the micro-Kjeldahl method. All pulses received identical treatment. The nonprotein nitrogen in the extract of the pulses was determined by precipitating the proteins in the extract with 10% trichloroacetic acid, centrifuging and determining the

nitrogen in the supernatant solution. The non-protein nitrogen content of the pulse was determined as follows:

10 g. of the finely powdered material was extracted with 100 ml. of 10 per cent trichloroacetic acid for one hour with occasional shaking. The contents were centrifuged and nitrogen determined in an aliquot of the supernatant solution by the micro-Kjeldahl method. The results are given in the Table I.

Discussion

Of the pulses studied, red gram *dhal*, horse gram, pea and soyabean *dhals* take quite a long time (90-155 min.) for softening, while the others take a comparatively less time (20-40 min.). In the case of red gram (*Cajanus cajan*) which is commonly used in the preparation of 'Rasam', the period of 90 minutes was reduced to 55 minutes by addition of 3-4 drops of oil and a pinch of turmeric powder (0.4 g.), a finding which agrees with household experience while there is no appreciable difference in the percentage of nitrogen extracted. Among the pulses studied, *Masur dhal* which cooks easily, gave the maximum percentage of extract-

able nitrogen (23.5 per cent). In the case of black gram, soyabean and cow pea *dhals* the percentage of nitrogen extracted varies from 7.7 to 10.8, while in the other pulses, larger amounts ranging from 15.5 to 23.5 per cent were extracted.

At the softening point, about 14 per cent of total N on an average was extracted in water. Further cooking did not have any appreciable effect in bringing more nitrogenous constituents into the extract. As can be seen from Table I, addition of tamarind and salt extracted quite a considerable portion of the non-protein nitrogen in the pulse, while no appreciable change was noticed in the quantity of total nitrogen extracted. One noticeable change, however, is in the cases of *Masur dhal*, Cowgram, Pea and Field bean *dhal*, in that a larger percentage of protein nitrogen is extracted as compared to other pulses. It may incidentally be noted that the 'Rasam' (containing tamarind and salt) as is commonly used at home retains quite a considerable percentage of protein nitrogen.

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TABLE I. Effect of cooking on the solubility of nitrogen in pulses

| Name of the pulse | Botanical equivalent | Time for softening (min) | Total nitrogen in the pulse % | Non-protein nitrogen | | Nitrogen extracted expressed as percentage of the total N of the material | | | | | | | | |
|-----------------------|------------------------------|--------------------------|-------------------------------|----------------------|-----------|---|--------|-----------------------------|-----------------------------------|--------|-----------------------------|--|--------|-----------------------------|
| | | | | | | At the softening point | | | 15 min. after the softening point | | | 15 min. after the softening point with tamarind and salt | | |
| | | | | % in the pulse | % of T.N. | Total N. | N.P.N. | Protein N. (by difference). | Total N. | N.P.N. | Protein N. (by difference). | Total N. | N.P.N. | Protein N. (by difference). |
| Red gram dhal ... | <i>Cajanus cajan</i> ... | 90 | 3.8 | 0.31 | 8.2 | 15.8 | 8.4 | 7.4 | 16.8 | 8.9 | 7.9 | 16.6 | 9.2 | 7.4 |
| | <i>Phaseolus aureus</i> | | | | | | | | | | | | | |
| Green gram dhal ... | Roxb. ... | 25 | 4.0 | 0.17 | 4.2 | 16.5 | 5.0 | 11.5 | 17.0 | 5.0 | 12.0 | 11.5 | 7.5 | 4.0 |
| Masur dhal ... | <i>Lens culinaris</i> Medic | 20 | 4.1 | 0.44 | 10.7 | 23.5 | 11.8 | 11.7 | 25.0 | 12.2 | 12.8 | 24.3 | 14.6 | 9.7 |
| Black gram dhal ... | <i>Phaseolus mungo</i> ... | 35 | 3.9 | 0.16 | 4.1 | 7.7 | 4.3 | 3.4 | 8.7 | 4.9 | 3.8 | 9.5 | 6.4 | 3.1 |
| Bengal gram dhal ... | <i>Cicer arietinum</i> ... | 35 | 3.7 | 0.28 | 7.6 | 15.4 | 7.6 | 7.8 | 16.5 | 9.7 | 6.8 | 15.1 | 10.5 | 4.6 |
| Horse gram ... | <i>Dolichos biflorus</i> ... | 95 | 3.3 | 0.44 | 13.3 | 18.2 | 15.8 | 2.4 | 18.5 | 15.8 | 2.7 | 18.2 | 16.4 | 1.8 |
| Cow pea ... | <i>Vigna catieng</i> ... | 35 | 3.8 | 0.21 | 5.5 | 10.8 | 3.7 | 7.1 | 12.6 | 4.5 | 8.1 | 17.1 | 5.0 | 12.1 |
| Soyabean dhal ... | <i>Glycine Max.</i> Merr | 155 | 6.8 | 0.22 | 3.2 | 9.0 | 5.2 | 3.8 | 8.7 | 5.2 | 3.5 | 9.0 | 7.5 | 1.5 |
| Peas, dried ... | <i>Pisum sativum</i> ... | 150 | 3.6 | 0.35 | 9.7 | 18.1 | 10.3 | 7.8 | 18.0 | 9.2 | 8.8 | 18.6 | 6.7 | 11.9 |
| Field bean dhal (dry) | <i>Dolichos lablab</i> ... | 40 | 4.5 | 0.24 | 5.4 | 15.5 | 5.1 | 10.4 | 17.7 | 6.2 | 11.5 | 17.3 | 5.5 | 11.8 |

LATHYRISM

By V. SUBRAHMANYAN, M. NARAYANA RAO and M. SWAMINATHAN

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Lathyrism is a degenerative disease of the spinal cord, giving rise to paralysis of limbs, especially the legs; it follows upon a long period of subsistence on diets, in which the principal ingredient is the pulse known as *lathyrus sativus* or other varieties of lathyrus species. In India, the disease occurs in Rewa, Bhopal, Central Provinces and Bihar, i.e., in regions where *lathyrus sativus* is consumed in excessive amounts by the people. Buchanan¹, Acton², and Young³ reported the occurrence of the disease in the Central Provinces. The incidence of the disease in Gilgit Agency in Kashmir was investigated by MacCarrison⁴ and MacKenzie⁵, in Uttar Pradesh by Stott⁶, in Bhopal by Shourie⁷, and in some districts of Bihar by Lal⁸. The disease has also been reported to occur in Spain, Algeria and less commonly in France and Italy⁹ where *lathyrus* peas are consumed by the people in certain restricted areas.

Clinical features of lathyrism: Acton² described four stages of the disease. The first stage is characterized by weakness of the lower limbs with spasticity of several muscles so that movements at the ankle and knee joints are restricted and painful. In the second stage flexion of knee is more marked and there is a certain amount of inversion of foot with a tendency to walk on toes. In the third stage, the symptoms described above become more marked and the patient can only walk with the help of crutches or sticks. In the fourth stage, the knees become completely flexed and erect and walking becomes impossible. There is atrophy of the thigh and leg muscles, knee jerks are brisk and plantar reflex is extensor. The onset of the disease in most cases is believed to be sudden. A person while working may suddenly get the disease when he will feel the loss of power in his legs and fall down. It has been reported that some persons may get the disease even during sleep. The patients whether they are in the early or late stages are

not known to recover the normal functions of the lower extremities at any time during their lives.

Investigations on *Lathyrus Sativus*: *Lathyrus sativus* belongs to the order of *Leguminosae* and gives pods containing seeds of the size of a pea. It can be cooked and consumed in the same way as other pulses. The crop grows vigorously even under rather unfavourable conditions, withstands drought to a considerable extent and thrives under conditions where crops like wheat and other grains would fail. During periods of famine and food scarcity it forms the staple article of the diet in certain regions in India. *Lathyrus sativus*, just like other pulses, is a good source of proteins containing about 28.2 per cent. The biological value of the proteins, however, has been reported to be rather low¹⁰. Basu *et al*¹⁰ reported a value of 44 by the nitrogen balance method and 0.6 by the rat growth method at a 15 per cent level of protein intake. Feeding experiments with the pulse on different experimental animals have yielded varying results. A syndrome resembling human lathyrism has been produced in monkeys by feeding the mature seeds of the lathyrus species or aqueous extracts of them¹¹. Fowls and pigeons have been reported to eat the *Lathyrus sativus* peas freely and with apparent immunity. Ducks and guinea pigs on the other hand are readily affected¹². Bhagvat¹² found that if guinea pigs were fed a diet containing *lathyrus* pulse to the extent of 50 per cent or more, their growth was retarded and the guinea pigs became dull and weak with disinclination to move; they also developed ulcers on hind legs and died after a few weeks. Acton and Chopra¹³ claimed to have isolated an active crystalline compound which in guinea pigs produced a transient spastic paralysis from which the animals recovered. The authors suggest that the same principle may be active in human lathyrism. Horses are said to be particularly susceptible, whereas rats

have been fed for periods of 2-4 months on diets consisting exclusively of *L. Sativus*, *Cicera* or *Clymenum* seeds without apparent ill effects other than slow growth¹⁴. McCarrison and Krishnan¹⁵ also showed that rats are not susceptible to lathyrism. Acton² reported that feeding ducks on *L. Sativus* caused paralysis and death in ducks, but if the pulse has been steeped in water for 24 hours and the soaked pulse fed to the animals, they thrive well on it. This work provided some evidence to show that the toxic principle is water soluble and can be removed by soaking the pulse for 24 hours in three changes of water. Early reports that the toxicity was caused by divicine, phytates or by lack of vitamin A or B-vitamins have been shown to be untenable^{16, 17, 18}. Certain Spanish workers¹⁹ suggested that a virus infection in conjunction with generally poor nutrition is responsible for lathyrism in man. Rudra²⁰ reported that selenium was probably the toxic agent present in *lathyrus sativus* and causing lathyrism in man. All the above claims cannot be regarded as well established and it appears that the etiology of human lathyrism still remains to be elucidated.

Investigations on other varieties of lathyrus peas:

Lathyrus odoratus: Geiger, Steenbock and Parsons¹⁶ produced toxic symptoms in rats by feeding the seeds of *L. odoratus*, the common flowering sweet pea. The animals survived for long periods on diets containing upto 50 per cent of *odoratus* meal and showed an extreme abnormality of the skeleton, including Kyphosis, increased shaft diameter, exostoses of the long bones and generalized osteoporosis. In addition, many of the animals developed hernia, a condition otherwise rare in rats. These symptoms are, however, found to be different from those of typical lathyrism, and Vivanco and Diaz²¹ suggested the term 'odora-tism' as more appropriate for the symptoms caused by *L. odoratus* in rats. Stamler²² reported that the feeding of *L. odoratus* peas actually interfered with the reproduction in rats. *Lathyrus* peas when added to the diet of pregnant rats, caused the death of fetal rat late in intrauterine life. Death was associated with poor development of the skeleton and

other mesodermal tissues and commonly resulted from the rupture of thoracic aorta at or near the time of birth. *L. odoratus* peas when included at a level of 50 per cent in the dietary did not affect the fertility of adult male or female rat. Male rats maintained on the diets for as long as ten months showed no histological evidence of testicular atrophy.

Lathyrus pusillus (Singletary pea): Lee *et al*¹⁸ showed that the ingestion of a diet containing 70 per cent singletary pea (*L. Pusillus*) seed meal led to the development of symptoms usually associated with lathyrism in albino rats. A deficiency within the ration was not found to be the cause, and the toxic principle was also not of the nature of an enzyme or inorganic material. The feeding of alpha tocopherol in large doses conferred some protection against the development of paralysis.

Later workers¹⁷ found that *L. hirsutus* and *L. tingitanus* also produce essentially the same condition in rats as *L. odoratus*. It was observed in some areas that *L. sativus* was contaminated with another pulse of the same species, *L. sphericus* which was reported to be toxic to rats²³.

Effect of varying level of dietary protein on the development of lathyrism in rats: It has been demonstrated that the protein content of the diet has a modifying influence upon the severity of skeletal deformity²⁴, and incidence of spontaneous aortic rupture²⁵ following the feeding of *L. odoratus* meal to growing rats. Lee and coworkers²⁶ studied the effect of varying levels of dietary protein on the development of rat lathyrism. Feeding of casein or casein hydrolysates was found to exacerbate the paralytic effect of the seed so that a reversible paralysis is produced which does not involve spinal compression or other severe skeletal changes. The skeletal and growth effects of the effective proteins have been attributed to result from the reversal of an interference with amino acid metabolism, protein providing either a select group of amino acids or a specific peptide. The exacerbation of the specific paralytic effect is then caused by the stress of more normal growth, combined with larger intakes of toxin.

Isolation of toxic factors from lathyrus species: The next significant development was the isolation of an active crystalline substance from *L. odoratus*²⁷ which was characterised as beta (N-gamma-L glutamyl) amino propio nitrile.

$$\begin{array}{c} \text{NH}_3 \\ | \\ \text{HOOC}-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CO}-\text{NH}-\text{CH}_2-\text{CH}_2-\text{CN}^{28} \end{array}$$

Dasler²⁹ and other workers³⁰ have shown that the toxic portion of the molecule is beta-amino propionitrile (BAPN). When fed at about 0.1 to 0.2 per cent of the diet, BAPN fully reproduces the same symptoms caused by the feeding of an equivalent amount of beta-(N-gamma-l-glutamyl-) amino propionitrile or a meal of *L. odoratus*^{31, 32}. In addition to bony changes, reproductive failure, dissecting aneurysm of the aorta³³ and degenerative arthritis³⁰ have also been reported to occur. Thus mesenchymal tissues are primarily affected in odoratism rather than nervous tissues as in lathyrism. The amounts expressed as mg. per cent of BAPN in the air dried sample of different varieties of lathyrus, have been estimated³⁴. The results are as follows: *L. odoratus* 58-160; *L. pusillus*—62; and *L. hirsutus*—21. BAPN was not found in *L. sativus*, *cicera*, *latifolius*, *strictus* or *splendens* or in a variety of other legume seeds including soya bean, edible garden peas, navy beans and cow peas. BAPN is thus characteristically

present in those lathyrus species that are toxic and produce skeletal changes in rats and absent from those that cause human lathyrism. An active crystalline substance was isolated from Singletary pea (*L. Pusillus*) by Dupuy and Lee³⁵. This substance appears to be the same as γ -glutamyl- β -amino propionitrile present in *L. odoratus*. *L. sylvestris Wagneri* has been reported to produce a syndrome unlike that obtained with the singletary pea³⁶. The toxic substance present in *L. sylvestris wagneri* was obtained in a concentrated form by Schulert and Lewis³⁶. Its chemical properties appear to be different from those of γ -glutamyl- β -amino propionitrile. No information is available regarding the chemical nature of toxic compounds present in *lathyrus sativus*.

Relative toxicity of compounds related in chemical structure of BAPN: Very little information is available as to the mechanism by which BAPN produces its striking pathological effects in animals. Bachhuber *et al*^{25, 37} tested the toxicity of twelve compounds, structurally related to BAPN in order to investigate the relation between structure and biologic activity. The results reported are given in Table I. From the table it is clear that only amino aceto nitrile and bis-(beta-cyanoethyl) amine have shown activity comparable to that of BAPN. Unlike BAPN which principally modifies bone

TABLE I. Assays on BAPN analogues in growing rats

| Chemical added % | No. of rats | Days fed | Weight gain and incidence of lesions | | | Disorders observed |
|---|-------------|----------|--------------------------------------|----------------|--------------------------|------------------------------|
| | | | g. per day | Fibrosis femur | Vertebral col. deformity | |
| 1. Control ... | 8(0)* | 50 | 1.57 | ... | ... | ... |
| 2. .20NH ₂ CH ₂ CH ₂ CN ... | 8(8) | 43-67 | .50 | 8 | 7 | Hernia 4 |
| 3. Control ... | 5(2) | 55-64 | 1.45 | ... | ... | Pneumonia 5 |
| 4. .15NH ₂ CH ₂ CH ₂ CN ... | 5(0) | 55 | 2.03 | 5 | 2 | Paralysis of hind limbs 1 |
| 5. .35HO CH ₂ CH ₂ CN ... | 6(2) | 52-56 | 1.31 | ... | ... | ... |
| 6. .35CH ₃ NHCH ₂ CH ₂ CN ... | 6(0) | 62 | 1.85 | ... | ... | Pneumonia 2 |
| 7. .35(CH ₃) ₂ NCH ₂ CH ₂ CN ... | 6(0) | 56 | 1.68 | ... | ... | " 1 |
| 8. Control ... | 5(0) | 49 | 1.60 | ... | ... | " 1 |
| 9. .30HCl NH ₂ CH ₂ CH ₂ CN ... | 11(9) | 36-49 | 0.73 | 11 | 7 | Hernia 3 |
| 10. .30NH(CH ₂ CH ₂ CN) ₂ ... | 11(1) | 45-49 | 0.44 | 11 | ... | Cerebellar incoordination 11 |
| 11. .30CH ₃ CONHCH ₂ CH ₂ CN ... | 11(6) | 44-49 | 0.79 | ... | ... | Pneumonia 7 |
| 12. NH ₂ (CH ₂) ₃ NH ₂ — ... | 11(0) | 45 | 1.38 | ... | ... | ... |

* No. of rats that died during the experiment is shown in parenthesis.

development and produces marked skeletal deformity, bis (beta-cyanoethyl) amine exerts an early and pronounced influence on the central nervous system and subsequently produces lesser skeletal alterations. It has been shown that substitution of a methyl or acetyl into the amino group or a substitution of hydroxyl for the amino group in BAPN results in a loss of biologic activity. No significant protection has followed the feeding of BAPN with such supplements as choline, methionine, cystine, betaalanine, pantothenic acid, or pyridoxine.

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ADVERSE WEATHER CONDITIONS AND SEASONAL FOOD SHORTAGES— A PRACTICAL APPROACH TO THE PROBLEM

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Periodical crop failures over small or large areas have been known in our country from the very early days. This has been due to a variety of causes of which the most important have been local or wide-spread drought or floods. Some part of the country or other is affected by these and depending on the magnitude people living in the regions are affected by them. The people who are worst affected are agricultural labourers and their dependants as also those with very low incomes, who cannot afford to move out or to purchase food at increased prices.

In the early days, when the communications were poor, such conditions often led to famine and deaths of a large number of people before any positive assistance could be rendered. Even when the State or other public organisations came to the assistance, the people could be just kept active through meagre sustenance, very often till the harvesting of the next crop.

Periodical failures unavoidable

Thanks to past experience and the precautions taken by the Government, there have

been no major calamities during recent years, though conditions of distress come up in patches as has been the case even during the current year. In fact, it will not be humanly possible to eliminate crop failures over short or large areas because of the adverse seasonal conditions. We have to accept them as inevitable and find ways of dealing with them. We also should expect that anti-social factors of the type which existed in 1943 in Bengal, will always be there and that they will exploit conditions of shortage irrespective of the misery, suffering and even death of fellow beings.

The country, as a whole, can and will produce more food. It is difficult to say whether we can go on producing enough to meet the needs of the fast growing population. Even if we have bumper crops over most parts of the country, patches of shortages are bound to occur here and there. Hardships are bound to ensue unless the people in the affected regions have the wherewithal to buy more food from where it is available.

The Government is well aware of this problem. It is a general policy to start construction works of one kind or another and to provide other means of employment in the affected areas. Even then, it will provide no more than bare sustenance and neither the Government nor the people concerned are happy over such an arrangement. The people wish to be independent and to have alternative sources to fall back upon. They would naturally prefer to have their own reserve of food which they can draw upon as and when required.

Periods of shortage affect man as well as farm animals—more so the latter. The animals are very important and valuable. One cannot afford to lose them. Any provision made for emergency should also include a stock or an easily available source of food for animals.

Subsidiary foods for man and animals

There have been discussions among nutrition workers as to what one needs during such an emergency. The requirements will depend to a large extent on the length of the emergency. If it is a long period, then the food should be properly balanced. Otherwise the health of the people will be seriously affected. In actual practice however, the distress extends over only

short periods—say, not more than four months. The people want something to eat, possibly in addition to whatever they may have on hand. It is, in fact, on this very principle that Government aid is also being given. The gruel centres are not meant to be attractive feeding houses. They are only meant to provide enough sustenance to keep people from the risk of starvation.

Even in times of distress the affected people find it no pleasure to proceed to a central place and to wait for long periods for the bowl of gruel or other food that may be given to them. The majority of them would like to have something which they can draw upon in their own houses. They would like it to be in some fresh condition, so that they can use it in a variety of ways.

Tapioca can help to meet emergencies

It has long been known that in Indonesia, as also in Kerala in our country, people do not suffer through having nothing to eat though they may be acutely hard up in other ways. In 1943, over a million people died of starvation in Bengal because of acute shortage of grain—chiefly rice—in that State. In the same year, the State of Travancore (now a part of Kerala) was even worse off in regard to grains but no one died of starvation in that State. The Famine Commission which went very carefully into the question came to the conclusion that the safety of Travancore lay in the abundant crop of tapioca which has long been used as a subsidiary food by the people. Practically, every home has some area under tapioca. The crop is a heavy yielder and with a small amount of attention and some manuring, even a small kitchen garden can provide enough starchy food to keep a family going for a few months. The crop can stay on in the soil and can be lifted up as and when needed.

Tapioca can be planted practically during any season of the year. It is propagated through cuttings. So, it will require some water and attention in early stages. Wet months are therefore the best for planting. Subsequently, it requires very little attention. It can withstand drought and even during seasons when the top withers away, there is usually a good development of the root at the bottom. Even if the conditions are very adverse, the root can be

harvested, cut into chips (with or without the skin) and dried. The chips keep well for several months and can be used as such (after steeping in water) or as flour.

Whether in the North of India or in the South, tapioca as the fresh root, chips, or as flour or *soji*, can find application. The material is essentially starchy and is preferably combined with wheat or any other grain or millet and used in the usual way. The possibilities in this line have been amply demonstrated by the Central Food Technological Research Institute, Mysore.

If, in any season, there is abundance of grain crops, there will be no need to draw on tapioca. It can be processed in the same way and used as auxiliary animal feed. It can also be used for industrial purposes. When there is shortage of grain, one can always draw on it as an article of human food. That has long been the policy followed in Indonesia.

Nutrition workers have never been in favour of extensive cultivation of tapioca—to the extent of displacing grain crops. The reason for this is not far to seek. Tapioca is predominantly starchy and contains practically no protein which we require for our growth and maintenance of good health. One pound of tapioca contains hardly 2 g. of protein whereas we require about 70 g. of protein per day, for the maintenance of normal health. It is because of this and the already existing high incidence of diseases arising through protein deficiency that the continued or exclusive use of tapioca as a major article of human diet is not recommended. The work done at the Central Food Technological Research Institute, Mysore has shown, however, that when combined with the commoner food grains to the extent of 25 per cent, it is not likely to do any harm. Actually there may even be some improvement in growth because of the effect of calcium—an essential mineral in which tapioca is generally rich. Tapioca is also rich in an essential amino acid (Lysine) in which some of the food grains are rather poor.

Our immediate object is to assist people in such a way that they will not have to face starvation or to depend on the Government or any charitable organisation in times of emergency. From this point of view people can be encouraged to grow tapioca essentially as a kitchen garden

crop. There will be need for propaganda and demonstrations especially in regions where there is likely to be frequent incidence of drought and other forms of distress. As an instance of this may be cited, the drier parts of Deccan which are mostly dependent on seasonal rains. This year, we are already having distress through drought in some parts of this area which are now distributed between the States of Mysore, Bombay and Andhra.

It should not be difficult to do propaganda and to distribute cuttings of tapioca. Some years ago, when distress conditions prevailed in Rayalaseema (now a part of Andhra) large number of people were fed continuously with tapioca foods. Thanks to the enthusiasm of the then Famine Commissioner of Madras (Shri Hejmadi, now Chairman of the Union Public Service Commission), large numbers of tapioca cuttings were distributed especially in Anantapur District. The distribution could not be followed by sufficient propaganda, but even then, quite a number of people grew tapioca and obtained good yields. If tapioca can survive under the trying conditions of Rayalaseema, it can do so with greater facility in other parts of the country.

Tapioca can meet shortage if grown as kitchen garden crop

It is not our object to encourage the displacement of any grain crop by tapioca. A fear has often been expressed by nutrition workers that any encouragement given for the cultivation of tapioca will result in people taking to it to the exclusion of the more desirable grain crops because it is easier to grow and requires practically no attention. We should give no chance for such a complaint. When introducing tapioca as a kitchen garden crop it should be made clear that it is undesirable to eat large quantities of the root because it is a poor article of food; that when plentiful supply of grains are available, the tapioca is best used as animal feed or for other purposes. The Government can also officially ban the cultivation of tapioca as a field crop—excepting in emergency, to the exclusion of any grain crop.

The above is not such a difficult problem as may first appear. Tapioca is well known in the coastal districts of Madras, but it is not used as a

normal article of food, except by a very small minority. People prefer to eat the grains. Tapioca is consumed only as a supplement and as an occasional vegetable. The same has been the experience in other parts of the country where tapioca was being grown as an experimental crop. It is only in Kerala that people have developed a taste for the root—especially in the coastal areas of Travancore. People—high or low, rich or poor—like the root as an article of food and use it in a variety of ways along with cocoanut. Some of the dishes are also quite tasty and a Travancorean likes to have them wherever he is. There is a great deal that the rest of India can learn from Travancore in this direction.

Taken on the whole, there is no lively risk of tapioca displacing grain crops if it is introduced exclusively as a kitchen garden crop. If its use is popularised in areas of the country which are frequently victims of grain shortage, we can largely minimise if not completely eliminate the dependence of people on charity—whether from the State or from the public—in times of distress. If there is plenty of grain, the root will not still go to waste. It can be easily utilised as animal feed or for industrial purposes as a source of starch.

Place of sweet potato in Japan

Tapioca is not necessarily the only root crop that can be used in times of emergency. Others like sweet potatoes can also be raised and used for the dual purpose of feeding man and animals. In Japan, sweet potato of the improved type, is grown and consumed in large quantities and forms an important part in the normal dietary of the people. There are new varieties of sweet potato which are rich in carotene and have a bland taste. Mangolies, Swedes and turnips—which are normally animal feeds—can also be used by man in times of emergency. There are also probably others which are more nutritious but we do not yet know much about them. We have some clear-cut knowledge about tapioca and we have also experience of its use in India. There is

therefore a case for encouraging people to start growing tapioca as a garden crop in potentially vulnerable areas. The Government can help by distributing cuttings and encouraging people to plant them in the right seasons. The uses of the root as a vegetable should also be popularised.

Areas with short supplies of grains

There are, of course, parts of the country, and even large areas in other parts of the World where the conditions of the terrain—apart from water supply—will make it difficult to grow grain crops. If such areas are also densely peopled—as in Kerala—the problem of finding sufficient quantities of grain for meeting the needs of the people becomes very difficult.

In industrially developed countries like the United Kingdom or Switzerland, the problem of food shortage will come only in times of extreme emergency such as the exigency of a war. Normally, the purchasing power of the people is so high that they can get the best food materials on a competitive basis from other parts of the World. Regions like the Kerala are naturally well endowed and can produce abundance of other types of crops—especially the valuable plantation crops—which can bring a good return. There would not have been any major difficulty if the problem is half or even two-thirds of what it is today. A large section of people, especially in the coastal areas have low purchasing power and they could not have subsisted but for tapioca. In a case like this where the root crop becomes inevitable and where all sections of people may not normally get adequate quantities of other protective foods, there is need to supplement the dietary of the people. This should be done in such a way that the supplement will form a normal part of the dietary of the people and that there will be no need to change the diet habits. A great deal of scientific and practical work in this direction has also been done at Mysore and it is hoped that it will soon be applied for the benefit of the people.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during May-June 1957 are given below:

S (IS) 205 (152)

Studies on peanut candies and soup powders, by Jagtiani, J. K. (May 11, 1957). Certain investigations on the preparation and preservation of 'peanut candies and soup powders' have been in progress for some time in the Division of Food Processing of the Institute. The speaker described briefly some of the results obtained in these preliminary investigations.

The problem of peanut candies has arisen as a result of demand from the armed forces who have laid down certain specifications for the product both with respect to its eating quality and storage life. The army authorities desire a shelf life of at least one year under tropical conditions of storage. The preservation of peanut candies presents a number of problems such as softening of nuts, rancidity in the nut, mould growth on the surface in soft boiled candies, etc. With a judicious use of antioxidants and fungistatic agents and with improved technique of making the product, some very encouraging results have so far been obtained and it is now possible to store the peanut candies for a period of about 6 months. Further work is still in progress.

With respect to investigations on soup powders, the speaker described few recipes and approximate data on the cost of the product.

Dr Bhatia, while supplementing the talk, gave details of further work with respect to the preservation of peanut candies and expressed the hope that, with proper packaging, it may be possible to prolong the shelf-life of the product to one year. With regard to soup

powders, he mentioned that the real problem in soup powder is to minimise the deteriorative changes that occur during storage. The product is very hygroscopic and therefore needs adequate packaging. With regard to the selection of the packaging material, one must bear in mind the relative cost of different materials.

During the discussion, information with regard to the packing of nuts in nitrogen atmosphere or in vacuum, use of different packaging materials and the nature of micro-flora in soup powder was sought.

Dr Girdhari Lal stated that the Division of Fruit Technology would also be interested in pursuing the work on soup powders and it was considered that future work on the subject should be done in joint collaboration of the Processing and Fruit Technology Divisions. The Chairman concluded the discussion by suggesting that work on both peanut candies and soup powders should be energetically pursued.

S (IS) 206 (153)

Role of pre-cooling on storage behaviour of vegetables, by Srivastava, H. C. (June 1, 1957). The technique of pre-cooling of perishables before transportation has been practised in U.S.A. since 1904, but proper scientific consideration to the problem was only given recently when it was discussed in the plenary session of IX International Congress of Refrigeration at Paris in 1955. Most of the work done so far in various countries is mainly on fruits having comparatively low respiration rates e.g., apples, pears, etc., but very scanty literature is available about pre-

cooling of vegetables having high respiration rates. Therefore, studies were undertaken to see the effect of pre-cooling on storage behaviour of some vegetables having high respiration rates like field and cluster beans, coriander leaves, and betel leaves.

The speaker then explained the principles underlying pre-cooling and told that, of various techniques known, only two were employed viz: 1) by cold room at 32-35° F and 2) by hydro-cooling at 33 ± 0.5° F. Presenting data on respiration rates, physiological losses in weight and commercial spoilage, the speaker pointed out that pre-cooling of the field beans by cold room technique for 14 and 24 hours reduced appreciably the respiration rates, physiological losses in weight and spoilage, and nearly doubled the storage life at room temperature when compared with the control. Similar results were obtained when the field beans were hydro-cooled at 33 ± 0.5° F for 1 or 2 hours. Prolonged pre-cooling showed more of spoilage and a little more respiration rates at the end of the storage periods. An interesting observation was made that after pre-cooling the development of fungal pathogen was slow. Therefore, an experiment was laid out where the field beans were inoculated with a pure strain of *Colletotrichum lindemuthianum* and then pre-cooled by both the techniques. It was found that both the methods retarded the pathogenic action of the parasite and when beans were hydro-cooled in an aqueous solution containing 500 p.p.m. of sodium hypochlorite, the spoilage was further reduced. The spores from such pre-cooled

beans showed a heterocaryotic growth on potato dextrose agar medium. Results presented on coriander leaves also showed a similar pattern. The speaker then discussed the possibilities of commercial exploitation of this technique to help short distance transport, and retail sale of green vegetables.

Dr Mathur then supplementing the talk explained the *Modus operandi* of the technique and told the house that studies on these commodities were purposely taken, as under Indian conditions pre-cooling of such commodities is possible on a large scale. Further he said that vacuum pre-cooling can also be undertaken for commodities like lettuce, betel leaf etc.

The talk was then followed by a discussion where stress was laid on large scale trials, work on other commodities, and trying of other techniques of pre-cooling. President then reviewing the discussion stressed that we must find out some means by which we may get a quick reduction in temperature of a commodity right upto the core. He expressed the need for large scale trials and the application of the method in commercial practice.

S (IS) 207 (154)

Proteins in plant foods. I, by Kuppuswamy S., (June 10, 1957). The speaker began by referring to the assignment from the I.C.M.R. to write up a review on the information available on protein-rich foods not normally consumed, but available in the country. It was later on agreed to widen the scope of the review, by including familiar foods as well so that it might be of value to all the regions of the World where protein malnutrition is prevalent.

Protein malnutrition chiefly covers the tropical and subtropical belts, extending from Indo-China over Burma, Indonesia, India, Ceylon, the Near East and large tracts of Africa to the West Indies, Central America and parts of South America. The main reason for the deficiency of protein in tropical countries, apart from paucity of

conventional protein-rich foods is the lack of knowledge regarding protein concentrates, chiefly of plant origin, surrounding them and the methods for processing them so as to render them suitable for human consumption.

It is true that plant proteins, as a class, are inferior in nutritive value to proteins of animal origin, due to deficiency in certain essential amino acids, general imbalance, or low biological availability of the amino acids and absence of certain factors like the Bifidus Factor and Vitamin B₁₂. But in mixtures which go to make up practical diets, the vegetable proteins mutually make up each others' deficiencies, so that by intelligent balancing, it is possible to approach the animal proteins in nutritive value.

In general, in protein concentrates of plant origin, the protein is associated with certain factors, chiefly in the form of indigestible carbohydrates and fibre which cause certain disorders and interfere with its digestion. Such undesirable components may have to be eliminated, or, at any rate, reduced to the minimum.

Talking first of cereals and cereal products, the speaker said that though cereals are poor in protein, their contribution to the protein content of tropical diets is substantial in view of the relatively large quantities consumed. Cereal proteins have a moderate biological value, with the exception of rice proteins. The limiting deficiency on cereal proteins is generally lysine, while wheat protein is also deficient in valine. Attempts to increase the protein content of cereals by suitable cultural methods may not in all cases increase their overall protein value, because it has been shown in the case of corn that the high protein varieties merely contain a higher proportion of zein, which is totally lacking in tryptophan as well as lysine. Among the by-products, rice, wheat, and corn germ contain proteins of high biological value. Bran and polishings have also possibilities of utilization as sources of dietary protein.

Passing on to legumes, the speaker observed that for vegetarians, as also those who cannot afford the price of protein-rich foods, legumes are the most important source of dietary protein. They provide certain essential amino acids, especially lysine, in which cereal proteins are deficient and thereby enhance the overall nutritive value of the proteins in the mixed diet. By themselves, legume proteins are not well-balanced in respect of all the essential amino acids and so, in general, their biological value is low as compared to the average animal protein. As a class, they are deficient in methionine. Recent work has shown that variations in the protein content and amino acid composition of legumes are much wider than was first anticipated. The variable effect of autoclaving on the protein value of legumes has been repeatedly confirmed. Consumption of certain legumes cause toxic symptoms, such as those associated with lathyrism, cicerism etc.

Soyabean can be rightly considered to lie in a class by itself that is intermediate between legumes and oilseeds, since it contains more protein than most legumes, but not quite so much fat as most oilseeds. It is only on processing that the best value of soyabean protein is seen. Optimally heat-processed, soyabean protein approaches the animal proteins in biological value. Its supplementary value to different cereal proteins has been amply demonstrated. Several methods of processing have been described in the literature and among the products, the milk and the curd are the best known. Fortified soyabean grits and soyabean flour are also finding increasing application in the human dietary. Soyabean sauce and other similar products represent predigested protein foods which are both palatable and wholesome.

In the discussion that followed, several points were raised bearing on the toxicity of high pulse diets, the low keeping quality of cereal

germ in spite of its high tocopherol content, the effect of manuring on the protein content and amino acid make up of plant foods, the effect of storage on the biological value of the proteins and the relationship of population

pressure on protein malnutrition.

Reviewing the discussion the President said that if proteins could be isolated from different sources, then the potentiality of such isolated proteins being available in the

desired proportions to overcome the amino acid imbalance characteristic of individual proteins, is great. He also stressed the beneficial effect of appropriate processing on the protein value of soya-beans.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Prevention of discolouration of lime juice

E (IS) 4393 (367)

May I know how discolouration of lime or lemon juice can be prevented? Can this be effected by the addition of ascorbic acid? (Calcutta).

No specific investigation has been carried out on the prevention of discolouration of lime or lemon juice by added ascorbic acid but the results available from similar types of investigations with other fruits indicate that a dosage of 100-150 mg. per 100 c.c. of synthetic ascorbic acid will prevent discolouration in juices for a period of 8-10 months. It is presumed that potassium metabisulphite will be used as a preservative in permissible doses.

Lemon squash can similarly be prevented from discolouration by the addition of 1 oz. of ascorbic acid for 100 lb. of the product.

Standards for rice bran

E (IS) 4812 (368)

Let us know whether there are any standards set for rice bran. How can the adulteration of rice bran with rice husk be detected? (New Delhi).

There are no standards laid down in our country so far for rice bran, rice husk meal or rice husk.

But the matter is under consideration by the Indian Standards Institution. There are some fairly simple methods available for the detection of the adulteration of rice bran with rice husk. These are as follows:

(a) Sieving the material. Rice husk is coarse while the bran is fine and can be separated easily.

(b) If the rice husk is finely ground it is not possible to detect by the above method. In such cases, it will be essential to determine the silica content, which is very high in case of husk while there is hardly any silica in the bran.

(c) Simple chemical tests are also available.

(d) The oil content of rice bran is 17-20 per cent while that of husk is about 2 per cent. If the two are mixed then naturally the oil percentage will come down considerably. This would be another method of detecting the adulteration.

Mustard for table use

E (IS) xxxx (369)

Would you give me the method of preparation of 'Coleman's mustard powder' meant for table use? Please also write to me about its recipes. (Hyderabad).

'Coleman's Mustard Powder' is a patent preparation and the details of its manufacture are not disclosed. However, the method of preparation of mustard powder for table use and recipes for the same are given below.

Mustard for table use is a mixture of mustard flour, wheat flour, cayenne, pepper, rape oil, common salt and turmeric in appropriate proportions. Two varieties of mustard seed, *Sinapis alba* or yellow mustard and *Brassica nigra* or black mustard are commonly used. Equal quantities are taken and cleaned free from dust and sand particles. The clean mixture is crushed between rollers and then pounded in mortars. The powder obtained is sifted. The impure flour of mustard passes through the sieve and the dressing is left as residue on the sieve. A second sifting yields pure flour of mustard and a second quality of 'dressing'. The 'dressings' yield a fixed oil which is used for mixing with rape and other oils. A portion of the fixed oil is sometimes removed by hydraulic pressure to increase the storage life of the flour.

Cayenne, pepper and turmeric are powdered. The ingredients are mixed well, passed through a fine sieve and bottled.

Recipe

| | I | II | III |
|----------------|--|-----------------|---------------|
| | lb. | lb. | lb. |
| Mustard flour | ... 28 | 20 | 28 |
| Wheat flour | ... 28 | 20 | 28 |
| Cayenne pepper | ... $\frac{3}{4}$ | $\frac{1}{2}$ | $\frac{5}{8}$ |
| Common salt | ... 10 | 7 | 8 |
| Rape oil | ... 3 | 1 $\frac{1}{2}$ | 2 |
| Turmeric | ... sufficient to impart the desired colour. | | |

Preparation of almond syrup

E (IS) xxxx (370)

What is the method of preparation of almond syrup and how is it preserved? (Dehra Dun).

Almonds of good quality, which do not give kernels of bitter taste, are selected and the shell removed by breaking with a hammer.

The almond kernels are soaked in almost boiling water for some time to remove the loosened peel.

The recipe is as follows:

| | | |
|--|-----|---------------------|
| Sugar* | ... | 40 lb. |
| Almond kernels | ... | 1 $\frac{1}{2}$ lb. |
| Citric or tartaric acid | ... | $\frac{1}{4}$ oz. |
| Essence (Kewra or rose), cardamom, saffron | ... | As desired |

* To yield 25 quart bottles.

Preparation: The peeled almond kernels are very finely ground in a mortar and pestle using small quantities of water during the grinding which is thereby facilitated. The thick paste of almond kernels is strained through a coarse muslin cloth to get milk of almond. The processes of grinding and straining are repeated 2-3 times. The sugar is mixed with $\frac{1}{3}$ its quantity of water and boiled until the temperature of the boiling syrup reaches 221° F. Small quantity of cow's milk is sprinkled over the syrup and boiling continued for another 5 minutes. Citric or tartaric acid in the proportion indicated above is then added. The impurities which form a scum at the top are removed and boiling of the syrup is discontinued. The milk of almond with the sugar syrup prepared in the manner described above are mixed and the mixture is boiled till the temperature reaches 223-224° F. After cooling the syrup, the desired additives viz., essence (Kewra or

rose or both), saffron, cardamom are added and the finished product is filled in thoroughly cleaned and sterilized bottles.

Preservation: The filled bottles are placed in hot water (200° F) for 25-30 minutes and sodium benzoate (dissolved in a small quantity of water) is added at the rate of 1 $\frac{1}{2}$ oz. per 100 pounds of the finished product and packed in bottles which should then be made air-tight. The filled bottles should be kept in a cool dry place. The squash is diluted 5-6 times with ice cold water for use as a refreshing drink.

Almond syrup is a popular beverage in North India and other hot and dry places. It is considered a tonic which quenches the thirst and refreshes the body. In places like Delhi and the Punjab, this is very much in demand.

Cashewapple wine

E (M) xxxx (371)

Please let me know the details of the method of preparation of wine from the cashewapple which is being wasted in these parts. (Cochin).

The fruit is steamed at 5 lb. pressure for 5 minutes to get rid of the excess of tannins. By this process, the tannin content of the juice is reduced from 0.34 to 0.07 per cent which is an essential prerequisite for all the fruit wines. The juice is then expressed in a basket press and sulphited with 75 p.p.m. of sulphur dioxide which is added in the form of potassium metabisulphite. Another method which is considered to be more efficacious in removing the tannins, astringency etc., from fresh extracted juice is by heating it with 0.35 per cent gelatin and 0.3 per cent pectin.

The average composition of the fresh juice which has a pale yellow colour and which forms 50-60 per cent by weight of the fruit is as follows:

| | | |
|------------------------|-----|--------|
| Total soluble solids | ... | 13.5°B |
| Total sugars | ... | 12.0 % |
| Acidity as citric acid | ... | 0.25 % |
| Tannins | ... | 0.34 % |
| pH | ... | 4.2 |

It is then inoculated with a fermenting starter of pure wine yeast. After about ten days, the fermentation is almost complete and the yeast settles down. The clear portion can be decanted, bottled and pasteurized.

The composition of the wine obtained after fermentation of the juice in the manner described above is given below:

| | | |
|-----------------------------|-----|--------------------|
| Alcohol | ... | 8.34 % |
| Reducing sugars | ... | 2.2 % |
| Volatile acidity | ... | 0.06 % |
| Tannin and colouring matter | ... | 0.0025 g./100 c.c. |

The cashew apple wine can further be distilled to get higher content of alcohol and is thus used as brandy. The product can find its way into the pharmaceutical industry or even exported, if not allowed to be used in the country in view of the prohibition policy.

Preparation of bamboo candy

E (IS) xxxx (372)

Bamboo shoots are found in abundance in our State and I am told that you have standardised a method to prepare candy out of it. Will you kindly inform me the details of the method? (Gauhati).

Bamboo shoots are used as an article of food by poorer classes of people during famines. Bamboos are found in the forests of Assam, Bengal, Bihar, Madhya Pradesh, Kerala, Madras, Orissa and Mysore.

For the preparation of edible products, stunted or mis-shaped shoots, which are not likely to produce good quality bamboos, may be used.

Tender bamboo shoots 1 $\frac{1}{2}$ -2 ft. long are selected and the sheaths or outer covering leaves are removed with a sharp knife. The tender portions are cut into rings or pieces of suitable size and green portions, if any, on the pieces are scraped off thinly. (Leafy portions towards the growing tip may be used for making chutney).

Tender bamboo shoots are bitter in taste. To remove the bitterness, the rings or pieces of shoots are

boiled in water 2-3 times for half an hour each time. The boiled pieces are pricked with stainless steel needles or forks.

Candying: The pricked rings or pieces of shoots are boiled for a few minutes in a 30° Brix sugar syrup. The syrup should completely cover the shoots. The shoots are allowed to stand in the syrup for 24 hours after which the percentage of sugar in the syrup is determined, by means of a Brix hydrometer. (It will be found to be less than 30° Brix due to the absorption of sugar by bamboo shoots).

The syrup is drained and its concentration increased by about 10 per cent by adding more sugar. The syrup is brought to a boil and poured back on the shoots. This is repeated every day until the con-

centration of the syrup reaches about 60° Brix. At this stage, a small quantity of citric or tartaric acid (about 0.1 per cent of the total weight of syrup) is added. Then, the strength of the syrup is increased by 5° Brix each day till it reaches 75° Brix. The product is kept in the syrup for a week or so after which period the shoots are boiled along with the syrup for about 5 minutes. While still hot, the syrup is drained and the pieces are rolled in finely ground sugar. The pieces are placed on wooden trays, dried in shade and packed in dry air-tight containers. The product is stored in a cool, dry place. If desired, individual pieces may be wrapped in cellophane paper.

Note: If any flavour is to be added, it may be added at the time of rolling the pieces into sugar.

Preservation of mango pulp

E (IS) 5268 (373)

May I request you to inform me the method of preserving mango pulp during all climates? (Kakinada).

Mango pulp (dried), can be preserved by the addition of potassium metabisulphite or calcium metabisulphite which is added before the mixture is put for drying. The quantity of preservative added varies from 1-1½ oz. for 100 lbs. of the mixture so that the finished product does not have more than 750 p.p.m. of SO₂, the limit prescribed by the F.P.O. The quality of the finished product can be further improved if the final stages of drying are done in a home drier.

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Notes and News

STATISTICAL NOTES

All-India Final Estimate of Kharif Pulses other than Tur 1956-57

| Crop | Area (Thousand acres) | | Production (Thousand tons) | |
|------------------|-----------------------------|---|-----------------------------|---|
| | 1956-57 (Final estimate) | 1955-56 (Partially revised estimate) | 1956-57 (Final estimate) | 1955-56 (Partially revised estimate) |
| Urd or Mash ... | 2,464 | 2 500 | 246 | 266 |
| Mung ... | 2,915 | 2,818 | 247 | 245 |
| Moth ... | 4,403 | 3,927 | 347 | 296 |
| Kulthi ... | 2,746 | 2,600 | 249 | 242 |
| Peas ... | 13 | 13 | 2 | 2 |
| Other pulses ... | 3,625 | 3,709 | 573 | 581 |
| Total ... | 16,166 | 15,567 | 1,664 | 1,632 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)

All-India Final Estimates of Black Pepper and Dry Ginger, 1956-57

| Crop | Area (Hundred acres) | | Production (Hundred tons) | |
|------------------|-----------------------------|---|-----------------------------|---|
| | 1956-57 (Final estimate) | 1955-56 (Partially revised estimate) | 1956-57 (Final estimate) | 1955-56 (Partially revised estimate) |
| Black Pepper ... | 2,336 | 2,325 | 316 | 321 |
| Dry Ginger ... | 397 | 398 | 149 | 153 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)

All-India Final Estimate of Sesamum, 1956-57

| | 1956-57 (Final estimate) | 1955-56 (Partially revised estimate) |
|----------------------------|-----------------------------|--------------------------------------|
| Area (Thousand acres) ... | 5,433 | 5,653 |
| Production (Thousand tons) | 451 | 457 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)

C.F.T.R.I. NEWS

The following distinguished persons visited the Institute during May and June, 1957.

12-5-1957. Dr R. N. Dixit, Chief Medical Officer, Surat.

27-5-1957. Mr Panchanga, Chief Research Officer, Central Water and Power Research Station, Poona.

5-6-1957. Mr P. V. R. Sharma, Chief Reporter, *Andhra Patrika*, Hyderabad.

10-6-1957. Mr Hertz, American Journalist, Minnesota (U.S.A.)

11-6-1957. Dr N. Keshava Iyengar, Director of Forensic Research Laboratory, Calcutta.

18-6-1957. Prof. M. S. Thacker, Director-General of Scientific and Industrial Research and Prof. Dewan Chand Sharma, Member of Parliament.

Appointment

Dr P. S. Ramamurthy has been appointed as Junior Scientific Assistant in the Division of Storage and Preservation.

Nomination

Dr V. Subrahmanyam, Director has been nominated as a member on the Technological Research Sub-Committee of the Indian Central Oilseeds Committee.

List of Papers Published

611. **Synthesis of riboflavin** by *Ermothecium Ashbyii*, by Lulla, B. S. and Johar, D. S., *J. sci. industr. Res.*, 1957, 16C (3), 45.

612. **Loss of sulphur dioxide in the bulk storage of fruit juices**, by Lal, G. and Jain, N. L., *Indian J. Hort.*, 1956, 13 (2), 1.

613. **Effect of a fungicidal wax coating on the storage behaviour of mangoes**, by Mathur P. B. and Subrahmanyam, V., *J. Sci. Fd. Agric.*, 1956, 10 (7), 673.

614. **Standardization of conditions for the production of Indian Multi-Purpose Food**, by Subrahmanyam, V., *et al.*, *Food Sci.*, 1957, 6 (4), 76.

615. **Nutritive value of Indian Multi-Purpose Food**, by Kantha Joseph, *et al.*, *Food Sci.*, 1957, 6 (4), 80.

616. **Supplementary value of Indian Multi-Purpose Food to poor vegetarian diets based on different cereals and millets**, by Kuppaswamy, S. *et al.*, *Food Sci.*, 1957, 6 (4), 84.

617. **The nutritive value of the proteins of Indian Multi-Purpose Food**, by Kuppaswamy, S. *et al.*, *Food Sci.*, 1957, 6 (4), 86.
618. **Effect of supplementary Multi-Purpose Food on the growth and nutritional status of school children**, by Subrahmanyam, V., *et al.*, *Food Sci.*, 1957, 6 (4), 89.
619. **The effect of supplementary Multi-Purpose Food on the metabolism of nitrogen, calcium and phosphorus in under-nourished children**, by Kantha Joseph, Narayana Rao, M., Swaminathan, M. and Subrahmanyam V., *Food Sci.*, 1957, 6 (4), 91.
620. **Treatment of Nutritional Oedema Syndrome (Kwashiorkor) with a low cost protein food**, by Subrahmanyam, V., *et al.*, *Food Sci.*, 1957, 6 (4), 93.
- Additions to the Library*
1. *Methods in medical research*, Vol. 6, 1954, by Steele, J. M., (Year book Pub. Chicago), pp. 271, \$7.00.
 2. *Rice we eat*, 1956, by Narayanswami, C. K., (All-India Khadi Board, Bombay), pp. 144. Re 1.00.
 3. *Inorganic nitrogen metabolism*, 1956, by McElroy, W. D., and Glass, B., (John Hopkins Pr.), pp. 741, \$10.00.
 4. *Elementary health science for tropical regions*, 1955, by Daniel, F., (Oxford Univ. Pr. Madras), pp. 160, £0-3-6.
 5. *Electronics manual for radio engineers*, 1949, by Zeluff, V., and Markus, J., (McGraw-Hill), pp. 879, Rs 63.00.
 6. *Electronics for engineers*, 1945, by Zeluff, V., and Markus, J., (McGraw-Hill), pp. 390, Rs 33.75.
 7. *Fundamentals of industrial electronic circuits*, 1947, by Richter, W., (McGraw-Hill), pp. 569. Rs 29.25.
 8. *Electron tube circuits*, 1950, by Seely, S., (McGraw-Hill), pp. 529. Rs 33.75.
 9. *Radio engineer's handbook*, 1943, by Terman, F. E., (McGraw-Hill), 1943, Rs 42.75.
 10. *Culture and marketing of Tea*, 1956, by Harler, C. R., (Oxford Univ. Pr. Madras), pp. 263, Rs 20.31.

TECHNICAL AID TO FOOD INDUSTRIES (published in July 1954), pp. xvi + 270.

This publication contains the views and suggestions of prominent scientists, leading industrialists and food technologists, and Government officials on the nature of technical aid needed by different food industries in the country. Up-to-date technical and statistical data are provided and an appendix embodying the conclusions of the Symposium as well as a comprehensive index are given.

Price: Indian = Rs. 5-0-0 (*postage extra*); Foreign = 10 shillings.

INDIAN FOOD LAWS (published in August 1954) pp. v. + 220.

This volume summarizes all important details regarding the history, operation and enforcement of the food laws existing in different States in India, definitions, descriptions and chemical standards for articles of food including permissible additives, (colours, flavours and preservatives) and labelling of foodstuffs. The large number of tables on the comparative chemical standards prescribed for different food commodities in various parts of the country make the book useful for reference and guidance for the public analysts and the legal profession.

Price: Indian = Rs. 4-8-0 (*postage extra*); Foreign = 10 shillings.

BROCHURE ON HOME-SCALE FOOD PREPARATIONS SERIES

This brochure contains 66 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, *viz.*, the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 55 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation; 'Indian Sweet Series' giving methods of preparation and preservation of 3 kinds of typical Indian sweets; and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products. **Price:** Re 1-0-0 (*postage extra*)

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

BIOCHEMISTRY AND NUTRITION

Studies on the nutritive value of Indian Wheat. Part II, by Banerjee, R. H. and Das, N. B., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 19.—The AA have studied the composition of several varieties of wheat grown in India with a view to assess their nutritive value. Thirteen varieties of wheat belonging to two species, *viz.*, *Triticum durum* and *T. vulgare* grown under dry as well as irrigated conditions have been analysed for their nitrogen, gluten, ether extract, crude fibre, calcium, moisture, ash, acid insoluble ash, phosphorus, nicotinic acid and average weight of 100 grains. The results show high figures for the protein content and the weight per 100 grains while the value for crude fibre, ash and phosphorus are low and that for gluten relatively low as compared to protein. Values for other constituents are within the normal range. In the case of *vulgare* wheats grown under irrigated conditions the fat contents are higher as compared to those grown under dry conditions. The nicotinic acid value is also found to be appreciably higher in wheats grown under irrigated conditions. There is not much significant difference in other constituents of the wheat samples whether grown under dry or irrigated conditions.

K.L.R.

Supplementary value of fresh jack fruit with or without honey to poor rice diet, by Siddappa, G. S. and Bhatia, B. S., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 23.—The AA have carried out feeding experiments on young albino rats over a period of 12

weeks incorporating fresh jack fruit pulp with or without honey in the rice diets in order to find out its supplementary value. Retention of calcium and phosphorus have been studied by following their metabolism in rats. Weekly growth have been recorded and the results have been tabulated. The figures for the average weekly increase in weight and food consumption show that the growth rate is not affected significantly even when 25 or 50 per cent of rice in the diets have been replaced by fresh jack fruit pulp. Addition of small quantity of honey, however, produces increased growth rate. The food intake in the case of rats fed jack fruit diet decreases and this decrease is restored to the level of that of the control group by the addition of honey along with jack fruit. Allowance being made for the differences in food in-take, it is found that the addition of jack fruit with or without honey produces larger gains in weight than in the control group. Results of retention of calcium and phosphorus do not show any significant difference in the body calcium and phosphorus for rats fed different diets at the end of 12 weeks of feeding. The addition of honey along with jack fruit helps in a higher retention of phosphorus than in the case of the diet containing jack fruit only. The present investigation clearly shows that addition of honey along with jack fruit has a beneficial effect on growth of rats.

K.L.R.

Variability in protein content of rice, by Sampath, S. and Seshu, D. V., *Curr. Sci.*, 1957, **26** (5), 139.—The AA have studied the variability in the protein content of rice

grown under different genetic conditions. Samples of paddy from fields which had been green manured only were air dried, hand husked and used for the estimation of nitrogen by Kjeldahl's method. The results given in a table show that rice varieties with long sterile lemma ('glumes') have a higher protein content than the commoner types with short sterile lemma. It is also found that tetraploids like *O. sativa* synthesised in the laboratory have a higher protein content than the cultivated diploids. The wild species like *O. australiensis* from foreign countries has more protein than is common in rice. However, these varieties are not suited for cultivation.

K.L.R.

Plant anticoagulants, by Pillai, N. C., Rao, G. J. S. and Sirsi, M., *J. sci. industr. Res.*, 1957, **16C** (5), 106.—Seven indigenous plants have been tested for their blood anticoagulant activity. The aqueous extracts from the latex of *Carica papaya* Linn. and fruit juice of *Citrullus colosynthis* Schard. contains blood anticoagulant factors with no observable undesirable effect. Aqueous extract of the mashed leaves of *Phyllanthus emblica* and squash of the fruit of *Vitis vinifera* exhibit fair anticoagulant activity, but they also show some lytic and agglutinating action. Aqueous extracts of the powdered stems and roots of *Andrographis paniculata*, *Picrorhiza kurooa* and *Boerhaavia diffusa* Linn. do not contain any anticoagulant principle.

Curcuma longa and bile secretion—Quantitative changes in the bile constituents induced by sodium curcuminat, by Ramprasad, C. and Sirsi, M., *J. sci.*

industr. Res., 1957, **16C** (5), 108.—Sodium curcuminat obtained from the pigment of *Curcuma longa* has been shown to differentially affect the individual constituents of the bile. Though the concentration of the solids decreases in the bile flow stimulated by the drug, this is compensated by the increased volume of bile secreted. Absolute values for the entire period of choleresis indicate increased total excretion of bile salts, bilirubin and cholesterol. The fatty acid contents remain almost constant.

Investigations on the fate of methionine-S³⁵ in irradiated rats, by Kumta, U.S., (Miss) Gurnani, S. U., and Sahasrabudhe, M. B., *J. sci. industr. Res.*, 1957, **16C** (5), 111.—The influence of total body X-ray irradiation on methionine has been studied by administering labelled methionine-S³⁵ to rats, half an hour before irradiation, and studying the uptake of radioactivity in various tissues and in the amino acid, inorganic salt and sulphate fractions of urine. A considerable proportion of the radioactivity is excreted in the urine in the form of inorganic salts. The activity in the inorganic sulphate fraction in irradiated rats is about 5 times that in control rats. A rupture in the C.S.C. bond as a result of irradiation is suggested.

Influence of banana on the intestinal synthesis of thiamine in rats, by Bhagavan, H.N. and Rajagopalan, R., *J. sci. industr. Res.*, 1957, **16C** (5), 115.—Supplementary value of banana to a poor rice diet and the influence of the fruit in thiamine synthesis were studied. A favourable growth response was obtained. The data collected showed that banana in the diet also improved the liver store of thiamine.

The amino acid constituents of palm gur, by Joshi, M. R., and Kamala Sohoni, *J. Sci. industr. Res.*, 1957, **16C** (5), 119.—The analysis of samples of palm gur belonging to the palmyrah and date palm varieties for their total nitrogen content has shown that 60-80 per cent of the total nitrogen is in the form of non-proteinaceous

material. The amino acid composition of the protein as well as the non-protein fractions have been qualitatively studied by circular paper chromatography. Most of the essential and some non-essential amino acids have been found to be present in the protein fraction of palm gur. Several bands corresponding to many important amino acids were also found in the non-protein fraction. The absence of peptides was made certain by the negative biuret test. The AA have also estimated the various amino acids present in the non-protein fraction using the chemical and microbiological procedures. The results indicate a large variation in the amino acid contents of the palmyrah and date palm varieties except for the leucine and threonine values. The amounts of cystine, tyrosine and threonine are greater than those of lysine and phenylalanine in both the varieties.

K.L.R.

DAIRY PRODUCTS

Studies in the autoxidation of ghee (butterfat). Part II. Absorption of oxygen, production of water and carbon dioxide during oxidation, by Siloo Vachha L., Leley, V. K., Narayana, N. and Daji, J. A., *Indian J. Dairy Sci.*, 1957, **10**(1), 6.—Autoxidation of cow and buffalo ghee have been studied at 98°C. The quantities of oxygen absorbed and, water and CO₂ produced have been estimated. Absorption of oxygen by both the samples follow the typical sigmoid curve characteristic of the autocatalytic reaction. Cow ghee absorbs oxygen less rapidly than buffalo ghee. This may be due to the presence of the antioxidant carotenoid pigments in the cow ghee which is getting gradually bleached. Buffalo ghee takes up nearly twice as much oxygen as cow ghee during the same interval of time. Three distinct stages of autoxidation can be recognised: (1) An initial induction period with an exceedingly slow rate of oxidation, (2) a buffer period during which the rate of oxidation increases linearly with the extent of oxidation

and (3) a rapid oxidation period during which the oxidation proceeds uniformly at a maximum rate. From extrapolation of the autoxidation curve, it has been deduced that the buffer periods of both the samples are more or less the same, but the time required for absorption of a unit quantity of oxygen for cow ghee is double that for buffalo ghee during the rapid oxidation stage. Water and CO₂ are formed from the very start of the autoxidation although during the first few hours there is no absorption of oxygen. It is, therefore, concluded that the production of water and CO₂ is due to the decomposition of the fat molecule itself and not due to oxidation by external oxygen. At any stage of oxidation in both the samples, the quantities of water produced are nearly 6 to 12 times those of CO₂. The graphs for water and CO₂ production are similar to the autoxidation curve. From the molecular ratios H₂O/CO₂, it is suggested that the formation of water and CO₂ may be the result of 2 or more independent reactions in the initial stages at least. But with the progress of oxidation, they seem to be produced in one or more mutually connected reactions.

Vitamin A in dairy products, Part V. Relative stability of synthetic vitamin A in ghee, oils and fat on storage, by Sampath, S. R., Anantakrishnan, C. P. and Sen, K. C., *Indian J. Dairy Sci.*, 1957, **10** (1), 34.—Ghee, vanaspati (hydrogenated groundnut oil), coconut, sesame, groundnut and refined groundnut oils were fortified with synthetic vitamin A acetate as well as vanitin (synthetic vitamin A acetate in vegetable oil) at different concentrations and stored with and without anti-oxidants in different trials for a period of 6 months.

Vitamin A was found to be most stable in ghee, slightly less in vanaspati and coconut oil and least in sesame, groundnut and refined groundnut oils. The peroxide development was most in groundnut, refined groundnut and sesame

oils, less in coconut oil and vanaspati and least in ghee. At higher level of fortification, synthetic vitamin A acetate in coconut oils and vanaspati on storage was as stable as naturally enriched vitamin A in ghee. There was no difference in the stability of synthetic vitamin A acetate and vanitin in fortified oils and ghee on storage. Incorporation of either butyl hydroxy anisole or ethyl gallate in ghee, vanaspati and oils had no influence on the stability of vitamin A during storage even though the latter suppressed the development of peroxides in vanaspati, groundnut, refined groundnut and sesame oils.

Fractionation of butterfat by urea complexes and its use in detecting adulteration, by Saroj Tawde and Magar, N. G., *Indian J. Dairy Sci.*, 1957, **10** (1), 43.—Urea combines with fatty acids to form complexes and this property has been made use of to detect adulteration of butterfat with hydrogenated fats. Urea forms a complex with 'cis' isomers much more readily than 'trans' isomers. This will be a basis to distinguish hydrogenated from non-hydrogenated fats because the former ones contain 'trans' isomers which are not present in natural fats. The AA have studied urea fractionation of two varieties of each of Belgaum and Saurashtra ghee samples adulterated with 5 per cent and 10 per cent hydrogenated vegetable oil. Three fractions of the urea fractionation have been obtained in each of the samples. The weight of the fraction, ratio of the weight of the fraction to the weight of mixed fatty acids, iodine value, saponification equivalent, refractive index and melting point of the three urea fractions have been determined in the case of natural fat as well as adulterated samples. The values for the various constants indicate that this fractionation is characteristic and can be used for detecting adulteration.

K.L.R.

FRUIT AND VEGETABLE PRODUCTS

Studies on the effect of canning and storage on the nutritive

values of some common vegetables. Part IV. Changes in ascorbic acid, thiamin, riboflavin and niacin value of green peas (*Pisum sativum*), by Malakar, M. G. and Banerjee, S. N. *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 27.—The changes brought about by blanching, autoclaving, and storage in the ascorbic acid, thiamin, riboflavin and niacin contents of green peas during canning have been reported in this paper. The results indicate that all the vitamins investigated are lost to some extent during blanching. Ascorbic acid is lost up to an average of about 23 per cent, thiamin 16 per cent, riboflavin 27 per cent and niacin 6 per cent. By autoclaving, 47.5 per cent of ascorbic acid, 17.6 per cent of thiamin and 11.8 per cent of niacin that remained after blanching are further lost. The canned products have been kept for a period of six months and the vitamins in the solid and liquid portions of the can have been determined at different periods of storage. All the vitamins except riboflavin are found to progressively decrease. During the six months storage period, 80 per cent of ascorbic acid, 29.5 per cent of thiamin and 47.7 per cent of niacin that remained after autoclaving are lost. There is, however, an increase of about 91 per cent in the riboflavin content during the same period, the value being nearly double of what remained after autoclaving.

K.L.R.

MICROBIOLOGY

Studies on the nutrition of lactic acid bacteria. 1. Amino acid requirements, by Gonsalves, A., *et al.*, *Indian J. Dairy Sci.*, 1957, **10** (1), 25.—The amino acid requirements of 20 streptococci and 18 lactobacilli, representing different species and strains isolated from *dahi* and also including some type cultures obtained from other laboratories, have been studied.

For the streptococci as a group, 8 amino acids, *viz.*, arginine, glutamic acid, histidine, isoleucine, leucine, methionine, tryptophan and valine, were found to be

essential. The organisms showed some differences in their demand for alanine, serine and threonine, but most of them could dispense with aspartic acid, cystine, glycine, lysine, phenylalanine, proline and tyrosine.

The lactobacilli were found to be more exacting than the streptococci in their amino acid requirements. All of them required essentially 7 amino acids, *viz.*, arginine, glutamic acid, isoleucine, leucine, tryptophan, tyrosine and valine, and in addition 2 or more amino acids. Methionine and phenylalanine were also essential for most of them. Glycine, lysine and proline were generally not required for the growth of these organisms. Proline was, however, found to be essential for *L. fermenti*.

Amino acid composition of *Aspergillus oryzae* and *Penicillium chrysogenum*, by Datta, J. and Battacharya, K. R., *Ann. Biochem. exptl. Med.*, 1957, **17** (1), 35.—The AA have studied the amino acid composition of two fungi *Aspergillus oryzae* and *Penicillium chrysogenum* grown in complex and synthetic media with a view to find out whether the culture medium has any influence on the composition. The complex medium consisted of peptone 1 per cent and malt extract 5 per cent in distilled water at pH 5.8 to 6.0. The synthetic Czapek's medium was made up of NaNO₃ 2 per cent, KH₂PO₄ 0.1 per cent, KCl 0.05 per cent, MgSO₄ 7H₂O 0.05 per cent, FeSO₄ 7H₂O 0.001 per cent and cane sugar 3 per cent in distilled water at pH 5.8 to 6.0. The dry culture after five day growth was hydrolysed with acid and the hydrolysate analysed by two-dimensional paper partition chromatography using phenol-water and n-butanol: acetic acid: water (4:1:1) as solvent system. All the essential and commonly occurring non-essential amino acids were found to be present in each sample. The quantitative amino acid composition of the two fungi is practically identical. The percentage of nitrogen in the case of *P. chrysogenum* grown in the synthetic medium is

nuch higher than the one grown in complex medium. The synthetic medium also increases the value of nitrogen in the case of *A. oryzae*, though only slightly.

K.L.R.

Amylases from soil actinomycetes, by Pant, K. D., (Mrs) Shete, K. and Krishna Murti, C. R., *J. sci. industr. Res.*, 1957, **16C**, 101.—Actinomycetes from Indian soils produce highly active amylases from media composed of cheap indigenous ingredients. Activity of the enzyme compares favourably with that of commercial brands of diastase.

The component fatty acids of *Aspergillus flavus* fat, by Singh, J., *J. sci. industr. Res.*, 1957, **16C** (5), 113.—The component fatty acids of the semi-solid fat elaborated by *Aspergillus flavus* grown on a medium containing sucrose and inorganic salts have been studied. The fat contains myristic acid, 0.5; palmitic acid, 24.0; stearic acid, 21.5; arachidic acid, 0.7; hexadecenoic acid, 2.4; oleic acid, 25.3; linoleic acid, 23.7; and elcosenoic acid, 1.9 per cent (w/w). The amount of hexadecenoic acid is low. The stearic acid content of the fat is relatively high as compared with the other cryptogam fats, and in this respect it has a close resemblance with many land animal depot fats.

OILS AND FATS

Test for mineral oil in edible oils and ghee, by Venkatachalam, V. and Sundaram, S., *Curr. Sci.*, 1957, **26** (5), 158.—The adulteration of edible oils and ghee particularly cocoanut oil with a highly refined and thin mineral oil known as 'white oil' is a common practice among oil manufacturers and vendors. Holde's test, though applicable for detecting even small admixtures of paraffin wax and liquid paraffin fails to detect even 10 per cent of white oil in admixture with cocoanut oil. The AA have substituted ethyl alcohol and water in varying proportions in place of distilled water in Holde's test and have found that 50 per cent alcohol was the most suitable concentration and 70 per cent second best. The procedure is to saponify the test oil sample with alcoholic potash by heating, cool the contents and to a portion of the liquid add 50 per cent alcohol and mix well. A turbidity appears if mineral oil is present. According to the AA, it is possible to detect by this test, adulteration of edible oils and ghee with as low as 1 per cent of the thinnest mineral oil.

K.L.R.

Detection of adulteration of ghee with Vanaspati: Part II. Measurement of turbidity temperatures with benzyl alcohol-glycerine as solvent, by Desika-

char, H. S. R., *et al.*, *J. sci. industr. Res.*, 1957, **16B** (5), 216.—Turbidity temperatures of ghee and vanaspati (in its context as an adulterant of ghee) were determined in different pairs of solvents and the turbidity temperature of vanaspati was found to be uniformly higher by 20 to 25°C. This suggested the possibility of a method of detection of vanaspati in ghee. Experiments to test this possibility were carried out using benzyl alcohol-glycerine as the solvent for fat. The ratio of this solvent pair optimum for the purpose in view and other procedural details for a tentative method are given. Supporting data to show that adulteration at the 20 per cent level can be detected by the new method are provided.

The turbidity temperature, as a characteristic of fat, is recorded for some of the more common edible fats. In so far as ghee is concerned, there is a large variation in this temperature. As reported in the literature with other solvent systems, turbidity temperature measured in benzyl alcohol-glycerine also is lowered by free fatty acids and raised by moisture. Elimination of one by extraction of the test sample with alkaline 70 per cent alcohol and of the other by drying (final and necessary step in the alcohol treatment) are referred to in the method.

PART II (Foreign)

ANALYTICAL

An improved method for estimating ascorbic acid in foods and biological material, by Moor, H., *Food Manuf.*, 1957, **32** (3), 119.—The estimation of ascorbic acid by titrimetric procedures particularly titrating with dichlorophenol-indophenol and also by the colorimetric method developed by Schmall and co-workers has many limitations and disadvantages. Solutions with less than 100 γ /ml. ascorbic acid content cannot be estimated by the above methods. The A. has developed an improved method of colorimetric estimation of ascorbic acid in foods and biolo-

gical material with an accuracy of ± 10 per cent. The method is based on the principle that ascorbic acid reacts with diazotised *o*-nitro aniline to produce a coloured reaction compound which can be extracted with aqueous NaOH to give a reddish blue solution. A recovery test is also conducted separately with the addition of a certain amount of standard ascorbic acid solution to the analysis solution. The extinction values of the main and recovery test solutions are then measured in a colorimeter against the blank test at 540 m μ . The ascorbic acid content in the experimental sample can be calcu-

lated from the given formula, based on the extinction values, the amount of sample taken for analysis and the amount of standard ascorbic acid added. Results of estimations of ascorbic acid in roasted coffee beans, skimmed milk powder, red wine, tonic and flour, reported in the paper show that the values obtained by the new method have a closer approximation than those got by the method of Schmall *et al.* and titration with dichlorophenol indophenol. It is possible to estimate as low a concentration of ascorbic acid as 0.5 γ /ml. in solutions or extracts of solid material by the new method.

K.L.R.

Use of granulated zinc columns for determining chlorinated organic insecticides, by Hornstein, I., *J. agric. Fd. Chem.*, 1957, **5** (1), 37.—As a measure of the insecticide present, the chlorine content of chlorinated organic insecticides is often determined. A simple procedure has been developed for the partial or complete removal of the organically bound chlorine as chloride ion by the percolation of an acidified solution of the insecticide through a granulated zinc column. The fraction of the chlorine removed as chloride ion is a function of the molecular structure of the compound and is a reproducible value for a given insecticide. The chloride ion liberated is determined by potentiometric titration with silver nitrate. Applied to formulations and technical products, the procedure has a degree of specificity not available in analyses dependent on total chlorine determinations.

Composition of volatile oil of black pepper, *Piper nigrum*, by Hasselstrom, T., *et al.*, *J. agric. Fd. Chem.*, 1957, **5** (1), 53.—The composition of the essential oil of black pepper, *Piper nigrum*, is described. The characteristic odour of this oil is due to hitherto unreported small amounts of oxygenated terpenes, of which piperonal, dihydrocarveol, caryophyllene oxide, cryptone, and an alcohol $C_{10}H_{18}O$ were isolated and identified. The results are for use in the formation of an acceptable synthetic pepper to be used in case of a national emergency.

The determination of grade strength of pectins by the Teepol-Gel procedure, by Olliver, M., Wade, P. and Dent, K. P., *Analyst*, 1957, **82**, 127.—The standard method for the determination of grade strength of pectins recommended by a Sub-Committee of the British Food Manufacturing Industries Research Association has many limitations. The AA describe in this note a modified procedure in which the pectin solution is mixed with a known quantity of Teepol or any suitable surface-active agent

before being boiled with sugar and acid to produce a gel of soluble solids content of 70.5 ± 0.5 per cent as read by a refractometer and a pH of 3.10 ± 0.05 . The gel strength is measured by using the Ridgeli-meter. The method of calculating the true grade strength of the pectin is given.

K.L.R.

The determination of lead and copper in organic materials (foodstuffs) by a dry-ashing procedure, by Abson, D. and Lipscomb, A. G., *Analyst*, 1957, **82** (972), 152.—A method of dry-ashing described has been found suitable for the preliminary destruction of the organic matter of a wide range of food materials before the determination of trace amounts of lead and copper. The sample material is sulphated, which permits ashing to be carried out up to a temperature of 550°C without loss of lead by volatilisation. An aqueous suspension of light magnesium carbonate is used as an ashing-aid when the amount of ash is small, being added to the sulphated sample after it has been charred and crushed to a powder. After solution of the ash, lead and copper are determined by measurement of the colours of the complexes formed in chloroform solution with diphenylthiocarbazone and diethylammonium diethyldithiocarbamate, respectively.

BAKERY

Lines of attack on dough chemistry, by Hlynka, I. and Anderson, J. A., *J. agric. Fd. Chem.*, 1957, **5** (1), 56.—The contributions of test baking, dough rheology, and analytical chemical procedures illustrate how several techniques can supplement one another in research on dough chemistry, though the first still provides the main criterion of flour quality. Newer developments in dough rheology include description of dough properties by means of structural relaxation curves and relaxation time spectra. Amperometric titrations and polarographic studies are among the recent analytical tools. Dough is

currently treated as a dynamic cross-linked polymer network in which protein plays a major role; but a detailed explanation of dough structure, consistent with all data obtained by all methods, has yet to be developed.

BEVERAGES

The antioxidant properties of ascorbic acid and its use for improving the shelf-life of beer, by Napier, C. E., *Wallerstein Lab. Commn.*, 1956, **19** (66), 193.—The chemical constitution and antioxidant properties of ascorbic acid and related products are discussed, and several examples are given where the practical application of ascorbic acid as an oxygen acceptor can delay the onset of oxidative deterioration of various foods. It is pointed out that there is a similarity between these food problems and the formation of chill and oxidation haze in beer. Particular reference is made to enzymatic browning of fruits involving oxidation of tannins, and to sugar protein complexes resulting from Maillard reactions (non-enzymatic browning).

The use of ascorbic acid to remove dissolved and head-space oxygen in bottled beer, as indicated in recent literature, is reviewed and recommendations for the practical application of ascorbic acid as an antioxidant in beer are given. It is stressed that the acid should be added as the beer goes to the storage tanks.

After a discussion of the possible mechanism of oxygen uptake by ascorbic acid in beer, the results of some experiments with treated beers are presented indicating a relationship between the 'air' ($N_2 + O_2$) content as determined by Mendlik's method, and the ascorbic acid uptake during pasteurization and storage. This may have some practical value in determining the optimum of ascorbic acid addition to beer.

BIOCHEMISTRY AND NUTRITION

Chemical effects of ionizing radiation on proteins. I. Effect

Effect of γ -radiation on the amino acid content of insulin, by Drake, M. P., *et al.*, *J. Amer. chem. Soc.*, 1957, **79** (6), 1395.—This study was undertaken to determine the radio-sensitivity of the constituent amino acids of a protein in order to provide information which might indicate the source of objectionable qualities of aroma and flavours that have been found to occur in the sterilization of food proteins by ionizing radiation. One per cent insulin in basic (pH 8.5) and in acidic (pH 3.0) solutions was subjected to 0, 10, 20 and 40 million r.e.p. γ -radiation doses. Cystine, tyrosine, phenylalanine, proline and histidine are demonstrated to be very radio-sensitive. Leucine, valine, lysine and arginine are significantly destroyed at the high irradiation dose level. The nitrogen-terminal amino acids of insulin, glycine and phenylalanine, are shown to be deaminated. Cysteic acid is identified in the hydrolysates of the irradiated insulin. An increase in molecular size of the irradiated insulin is reported.

Effect of desoxycorticosterone acetate upon the apyrase activity of rat liver mitochondria, by Maruyama, K. and Kobayashi, H., *Enzymologia*, 1957, **18** (2), 135.—Desoxycorticosterone acetate (DOCA) caused an appreciable increase in the latent apyrase activity of rat liver mitochondria, especially in the presence of 6 mM $MgCl_2$ at pH = 7.1 and 25°C. On the other hand DOCA slightly inhibited the apyrase activity of mitochondria, which were activated by either 'aging' or adding 1×10^{-4} M 2, 4-dinitrophenol or $1-10 \times 10^{-4}$ M $-CaCl_2$. The effect of DOCA was observed in the enzymic hydrolysis of adenosine triphosphate and not of adenosine 5-phosphate and also of inorganic pyrophosphate. Of the steroid hormones tested progesterone and DOCA alone activated the apyrase activity.

Ascorbic acid in some oleiferous brassicas cultivated in Pakistan, by Tremazi, S.A., *Brit. J. Nutr.*, 1957, **2** (1), 1.—

Oleiferous brassicas grown in Pakistan as oilseeds and fodder crops are eaten as vegetable when the plants are young. The ascorbic acid content of this leafy vegetable has been estimated by the 2:6-dichlorophenolindophenol method. Stems, branches, leaves and buds of the plant, fully grown immature and mature seeds before and after germination in the case of four varieties of brassicas *viz.*, two forms of Japan rape, brown seeded sarson and toria were analysed for their ascorbic acid content. The results show that the edible portion i.e., leaves and buds are exceptionally rich in ascorbic acid which does not decrease appreciably even after a storage period of 24 hours after picking, which is usually the maximum time before the vegetable is eaten. It is also found that there is not much loss of ascorbic acid even on boiling the brassicas for 15 minutes and the small loss is due to diffusion of ascorbic acid into the cooking water. The concentration of ascorbic acid in the mature seed was very low and increased considerably on germination, the amount in seedlings 3 days old being about six times more than in the seeds.

K.L.R.

Biological value of the proteins of fish meals, by Bender, A. E. and Haizelden, S., *Brit. J. Nutr.*, 1957, **2** (1), 42.

Fish meals are prepared under varying conditions in different countries and it is possible that fish protein might be damaged during drying. The AA have therefore, analysed twenty-seven commercial fish meals and defatted and deodorised fish flours intended for human consumption. The values for protein, minerals, fat, net protein utilization, digestibility of the protein and the biological value of the protein have been reported in a table. The net protein utilization ranges from 80 for undamaged fish meal to values as low as 18 for grossly maltreated fish flour. Many of the samples of fish meal have been tested before and after defatting and deodorisation. The results

show that there is no evidence of damage caused by this treatment.

K.L.R.

Effect of pantothenic acid on growth and blood picture in the rat, by Blunt, A. D., *et al.*, *Brit. J. Nutr.*, 1957, **2** (1), 62.—One hundred and one black-and-white rats were fed from weaning or from 7 days after weaning on a purified diet with all vitamin supplements except pantothenic acid. They were dosed daily with 25, 50, or 100 μ g. pantothenic acid either after 2 weeks' deprivation or from the beginning of the test. Another group of seven animals was maintained for 7-11 weeks on the purified diet without dosing and then given a small dose of pantothenic acid for 4 weeks. The response in growth and blood formation was studied. Very little gradation of response in growth was observed with the daily dose of 25, 50 and 100 μ g. pantothenic acid. Male rats were more sensitive than female rats in their growth response to pantothenic acid. Although a daily dose of 25 μ g. pantothenic acid was almost adequate for growth, it did not completely prevent the greying of the black parts of the coat. In rats deprived of pantothenic acid the red-cell count increased and the cells were microcytic and hypochromic. There was no anaemia. In pantothenic acid deficiency the number of white cells did not change.

FRUIT AND VEGETABLES

Composition of commercial, segment, and peel juices of Florida oranges, by Swift, L. J. and Veldhuis, M. K., *J. agric. Fd. Chem.*, 1957, **5** (1), 49.—Comparative composition studies were conducted throughout a season. Peel juices were always highest in pH, Brix-acid ratio, soluble pectic substances, ascorbic acid, flavonoids, diacetyl, and colour, and lowest in acidity and fluorescence. Peel juices were usually highest in soluble solids, specific gravity and viscosity. During the early part of the season, sucrose was lowest and reducing sugars were highest in

peel juices. Peel juices added at a level of 3 per cent in reconstituted concentrate were detected with significance by a taste panel.

Softening of cucumbers during curing, by Demain, A.L. and Phaff, H.J., *J. agric. Fd. Chem.*, 1957, **5** (1), 60.—Cucumber softening during curing results in large losses to the pickle industry. Disintegration of the tissue is due to the breakdown of the pectic materials in the middle lamella. Pectic enzymes, which catalyze the hydrolysis of pectic materials, occur widely in nature. However, the possible sources of the softening agent(s) are limited to those enzymes which are not inactivated by the acidity and salt content existing in the brine. The aerobic bacilli, once considered to be important spoilage organisms, appear to play a less prominent role in softening than was thought formerly. The probable causes are fungi introduced via heavily contaminated cucumber flowers and the cucumbers (and accessory parts) themselves.

The determination of traces of mercury in apples, by Abbott, D. C. and Johnson E. I., *Analyst*, 1957, **82**, 206.—The method of Klein for the determination of mercury residues in foods gives low figures in the case of apples sprayed with mercurial formulations. The AA have modified the method slightly and have been able to get 90 to 95 per cent recoveries of mercury. According to the modified method, the apple slices are refluxed with a mixture of sulphuric and nitric acids in presence of selenium powder. The refluxed solution is adjusted to an acidity of 1 N and shaken with hydroxylamine hydrochloride solution and chloroform. The chloroform layer is separated after repeated extractions and the optical density of the chloroform layer is read in a 4-cm. cell against chloroform at 490 m μ . The amount of mercury corresponding to the optical density reading can be directly obtained from a standard curve of optical densities against known quantities of mercuric

chloride. The details of the modified procedure have been described.

K.L.R.

INSECTICIDES

Residues in crops treated with isopropyl N-(3-Chlorophenyl) carbamate and isopropyl N-Phenylcarbamate, by Gard, L. N. and Reynolds, J. L., *J. agric. Fd. Chem.*, 1957, **5** (1), 39.—The analytical method for the measurement of isopropyl N-(3-chlorophenyl) carbamate in experimental field plots is applied to grapes, tomatoes, carrots, sweet potatoes, strawberries, and peaches: peas were tested for isopropyl N-phenylcarbamate residue. Average recovery of added values of the herbicides to untreated crops was about 89 per cent by this method. Results show that the harvested crops which had been treated with isopropyl N-(3-chlorophenyl) carbamate did not contain herbicidal residues in excess of 0.05 p.p.m. which is the low sensitivity limit of the method.

Determination of residual p-chlorophenyl p-chlorobenzene-sulfonate in orange pulp, by Butzler, G. J., Luce, E. N. and Wing, R. E., *J. agric. Fd. Chem.*, 1957, **5** (1), 42.—A new method for the determination of the acaricide, Ovex, in orange pulp involves hydrolysis of Ovex to p-chlorophenol and sodium benzene sulfonate. The p-chlorophenol, recovered by steam distillation, is nitrosated, chromatographed, and measured colorimetrically. This procedure eliminates the phenoliclime impurities, making it possible to determine less than 5 γ of Ovex with a recovery of at least 90 per cent.

Flavour of selected vegetables grown in pesticide-contaminated soils, by Gladys Gilpin, L., Parks, A.B. and Reynolds, H., *J. agric. Fd. Chem.*, 1957, **5** (1), 44.—Undesirable off-flavours were detected in carrots, turnips, and green beans which were grown without insecticide treatment in soils contaminated with residues of technical benzene hexachloride (BHC) or lindane applied to preceding crops. Soil residues of the

alpha, beta, and delta isomers of BHC also resulted in off-flavours in carrots. Heavy residues of aldrin (both technical and purified), dieldrin, heptachlor, Dilan, toxaphene, chlordan, endrin, isodrin, TDE, technical DDT, and methoxychlor did not cause significant flavour changes.

MICROBIOLOGY

Factors influencing the production of polyhydric alcohols by Osmophilic yeasts, by Spencer, J. F. T. *et al.*, *J. agric. Fd. Chem.*, 1957, **5** (1), 64.—Certain osmophilic yeasts produce considerable quantities of glycerol, erythritol, and D-arabitol during normal growth. A culture producing good yields of glycerol and D-arabitol was grown successfully in 5-liter stainless steel fermentors. Satisfactory yields of glycerol and D-arabitol were obtained using a glucose—yeast extract—urea medium, but corn steep liquor could be substituted for yeast extract if higher concentrations of urea were used. Increased rates of aeration decreased the rate of glucose utilization and the yield of ethyl alcohol and increased the glycerol yield, while the yield of D-arabitol was not affected by changes in aeration. Increasing the fermentation temperature, to 37°C, increased the yield of glycerol and the rate of glucose utilization. The initial glucose concentration could be raised to 30 per cent without decreasing the amount of glucose converted to polyhydric alcohols. Ratios of glycerol and D-arabitol produced to glucose metabolized of 0.29 and 0.31 gram per gram, respectively, giving a combined yield of 0.60 gram of polyols per gram of glucose have been obtained.

Yeasts in Nature, by Lund A., *Wallerstien Lab. Commn.*, 1956, **19** (66), 221.—From their habits in nature, wild yeasts and other microorganisms can be conveyed, by the air or other means, into the plants of fermentation industries. If conditions there are favourable to their growth, they will form seats of infection, and may then exercise

a harmful influence on beer and other fermentation products.

The writer has studied the numbers of yeast cells that can be found in various substrates in nature, in order to extend our knowledge of the habitats of yeasts and their cycle in nature. A number of selective nutrient media are described which permit growth of accompanying molds. In the present studies counts of yeast cells in various substrates were made by means of platings on hopped wort agar to which sodium propionate had been added.

Sweet fruits such as strawberries, gooseberries, and raspberries frequently contained large numbers of yeast cells. Such fruits, in addition to mushrooms, exudates of trees, and insects which visit flowers, are considered especially important as habitats of yeasts.

Yeasts were also found frequently on grains of barley. They occurred more abundantly on grains taken from fields just before harvest, than on threshed barley tested upon its arrival at the brewery.

From their different habitats yeasts are conveyed to the soil. Yeasts were found in widely different types of soil. The largest number of yeast cells was found on the surface of the soil or in the upper soil layers. The number usually decreased rapidly with increasing soil depth. Experiments showed that yeasts are capable of reproducing in soil, but, it appears, only in soil of a specific nature. The presence, in the soil, of remnants of fruits, fleshy fungi, or other favourable substrates is essential for growth of yeasts.

When samples of soil from the same locality were tested in late summer and in early spring, it was found that only samples of surface soil showed any seasonal differences: a smaller number of yeast cells

occurred in most cases during the hot season. In this connection, experiments on the effect of heat, drying out, and light in various yeasts are mentioned. Species of various yeast genera could be destroyed at temperatures of between 35 and 43°C. Many yeasts were destroyed when soil moisture dropped below about 7 per cent. Some yeasts were destroyed by exposure to sunlight, or ultraviolet light from a quartz mercury lamp.

Most of the yeasts isolated by the writer from the various substrates belonged to asporogenous genera, especially *Candida* and *Torulopsis*. On barley grains, *Rhodotorula* and *Sporobolomyces* were common. Ascosporogenous yeasts occurred more rarely, but a number of species of these were found, particularly in soil samples. Most of these belonged to the genus *Hansenula*.

It is believed that brewers' yeast, whether top-or bottom-fermenting, do not thrive in nature.

TEA

Principal constituents of tea leaf, by Keegel, E. L., *Coff. and Tea Industr.*, 1957, 80 (2), 69.—The important constituents of the tea leaf are a group of soluble substances referred to as oxidisable matter together with pectins, caffeine and aromatic compounds. The fermentation of the oxidisable matter is effected by enzymes present in the leaf during the rolling process. The oxidisable matter, accounting for 35 to 40 per cent of the dry matter in the leaf is made up of substances called 'catechins' or 'polyphenols', sometimes wrongly given the name tannins or tannic acids. Seven different and distinct catechins have so far been identified and many others may be present in small quantities. The catechins are soluble in water and a number

of organic solvents such as ethyl acetate. They are mostly responsible for the pungency and quality of tea and to a great extent contribute to the colour and strength of tea liquors. The enzymes present in the leaf oxidise the catechins resulting in the formation of larger molecules which are much more stable. The fermented leaf gives a liquor of the desired reddish brown colour.

K.L.R.

Enzymes in tea leaf, by Keegel E.L., *Coff. and Tea Industr.*, 1957, 80 (3), 69.—In this article, the A reports the nature of enzymes present in the tea leaf and the mode of its action in fermenting the leaf. The specific enzyme is known as 'tea polyphenol oxidase' which only oxidises polyphenols resembling the tea catechins. This enzyme takes up oxygen from air, attacks part of the catechin molecules, which then take up oxygen and start 'condensing' or clumping together to form larger molecules responsible for the desired colour and aroma. The enzyme is supposed to have a protein carrier with an associated copper compound which oxidises on exposure to air and then passes the oxygen on to the polyphenols in the tea leaf. The 'reduced' copper takes up more oxygen from air and so it goes on oxidising the polyphenols coming in contact with it. The enzyme is most active between 80 and 90°F. Below 60°F, its action is slow and the enzyme is completely destroyed at temperatures above 120°F. These favourable conditions for the fermentation by the enzyme are created during the rolling process in the manufacture of black tea. The extent to which the fermentation should be allowed in order to get the desirable strong red coloured tea liquor is given. Over-fermentation is stopped by the process of firing the leaves before the colour becomes dark and dull.

K.L.R.

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SPIN PASTEURIZER—ITS PRINCIPLE, PERFORMANCE AND INDUSTRIAL APPLICATIONS

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It is now well recognised that in many canned foods, quality factors such as colour, flavour, texture and vitamin content are most effectively preserved by high-temperature short-time (H.T.S.T.) processes. This has a bearing on the postulation that for each 18°F (10°C) rise in the processing temperature, the destruction of micro-organisms increases approximately 10-fold while the chemical reactions responsible for product deterioration are nearly doubled. Commercially, this may be accomplished through 'flash-sterilization,' and 'agitating processes'. However, flash pasteurizers have not been entirely successful in the efficient processing of semi-fluid or viscous products like citrus concentrates, on account of their high viscosity and because of the presence of discrete particles which results in overcooking, scorching and the accompanying undesirable changes in colour and flavour of the product. Therefore, an efficient method of agitation of products like citrus concentrates to

produce 'commercial sterility' of the contents of the can with the least damage to the product during heating has been greatly needed by the industry.

The present report deals briefly with the working principle, performance, advantages and the industrial applications of a new 'spin-pasteurizer' (plate), which the author used for fifteen months during his overseas deputation at the Division of Food Preservation and Transport, Homebush, N.S.W., (Commonwealth Scientific and Industrial Research Organisation, Australia) in his investigations on the thermal processing of citrus concentrates and a number of other commercially important fruit products like tomato paste, tomato juice, passion fruit pulp and juice, pineapple concentrate, canned mango slices, orange segments, peaches, pears and berries in syrup. A summary of the results on Thermal Processing (Spin-pasteurization) of citrus concentrates has already been reported elsewhere,¹⁻³ while detailed reports on other products will be published later. The working principle, description, performance and advantages accruing from this spin-pasteurizer are as follows:—

Working Principle and Description:

The underlying principle is that the cans rotate axially when placed horizontally on a moving belt at an inclined angle. The steam and water are introduced in the form of fine sprays through small orifices in steam and water pipes fitted suitably above the cans on the moving belt. The whole unit is enclosed in a metal box made of aluminium, stainless steel or any corrosion resistant metal with suitable arrangements for the convenient introduction and kicking out of cans from the cooker (Plate). With the help of a variable speed motor and reduction gear unit, the belt speed and hence the speed of can rotation which has an important bearing on the rate of heat transfer is conveniently controlled.

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Methods

Heat penetration measurements were made by using 'Speedomax' single-point recording potentiometer and suitable copper—constantan thermocouple wires. 32°F was used as reference temperature at the cold junction. The hot junction in the can was connected to the recording potentiometer through external mercury contact as illustrated in the plate.

Results and Discussion

Based on earlier extensive work⁴ by the author at the C.S.I.R.O., Division of Food Preservation, Australia, the optimum speed of rotation for most of the fruit products ranged from 100 to 200 r.p.m. There are quite a number of other factors which govern the rate of heat-transfer during spin-heating-cooling, the notable among them being viscosity, container size, headspace, retort temperature, etc. Depending upon the nature and viscosity of the product, spin-processing⁵ takes one half to one tenth the time normally taken in the conventional stationary processing to get a definite can centre temperature of say 195°F. as illustrated in the table.

TABLE. Comparative efficiency of spin-pasteurizer in relation to stationary thermal processing in atmospheric steam (207°F)

| Product | °Brix at 20°C | Viscosity† at 20°C (Centipoises) | *Processing time (Minutes) | | | |
|-----------------------------------|---------------|----------------------------------|----------------------------------|--------------------------------------|--|--|
| | | | Spin processing (180 r.p.m.) (a) | Stationary processing (0 r.p.m.) (b) | Efficiency ratio of spin pasteurizer (a:b) | |
| Water ... | 0 | 1.0 | 1.15 | 1.6 | 1: 1.4 | |
| Lemon juice (single strength) ... | 8.3 | 2.0 | 1.15 | 2.0 | 1: 1.7 | |
| Lemon concentrates (4 fold) ... | 34.0 | 43.9 | 3.00 | 29.3 | 1: 9.8 | |
| Lemon concentrates (6 fold) ... | 48.0 | 527.2 | 5.25 | 48.3 | 1: 9.2 | |

* The processing time covers the total time taken for a can centre to acquire a temperature of 195°F and also the time taken to cool the contents from 195° to 100°F.

† Viscosity was determined with Brookfield Synchroelectric Viscometer in a room at constant temperature (20°C).

N.B. Can size = 202 × 214 with normal headspace (4").

From the data presented in the table, it would be of interest to note the following points:

1. The spin-pasteurizer remarkably reduces the processing time in relation to stationary processing of 4-fold lemon concentrate (34°Brix) by a factor of about 1/10.

2. At very high concentrations as in 6 fold lemon concentrate (48°Brix) with as high viscosity as 527 centipoises, the comparative rate of heat-transfer even during spin-processing is slightly slowed down, though still the efficiency ratio is 1:9.2.

3. In single-strength juice, however, the advantage is much less, the efficiency ratio being only 1:1.7. Nevertheless, in exceptional cases like passion fruit pulp and juice (containing starch 1.4-2.7 per cent⁶), the spin-pasteurization again offers special advantages in processing, because flash-pasteurization of passion fruit juice has failed (due to the gelatinization of starch at high temperature, it clogs up the coils of the flash-pasteurizer, apart from the juice acquiring a cooked flavour⁶). In addition to this, the spin-pasteurizer offers the following advantages:

1. Higher processing temperature could be used with closer control of process time and without scorching or overcooking of viscous and heat-sensitive concentrates and other fruit products.

2. Agitating cooking would result in the retention of better colour, flavour and nutritive value.

3. A wider range of processing time and temperature would be available for products of different ranges of viscosity and in several can sizes thus allowing the processes of the same F_0 value to be selected on the basis of the degree of cooking desired for individual products.

4. Heat sensitive fruit products could be sterilized in larger can sizes without over-cooking or loss in flavour.

5. Heat resistant organisms could be destroyed without heat injury to the product.

Spin-Pasteurizer—A Multi-Purpose Unit

Spin-pasteurizer has several industrial applications as follows:

(i) Preliminary trials conducted by the author at the C.S.I.R.O. indicate that in addition to

citrus and pineapple concentrates, the spin-pasteurizer, would be quite adaptable for the processing of other delicately flavoured and soft-textured fruits like canned *mango slices* and *orange segments* in syrup.

(ii) It is admirably suitable for canning of viscous products like fruit pulps, pastes, etc. viz., tomato paste, tomato puree, mango, papaya, apple and passion fruit pulps etc.

(iii) Spin-cooker has been very successfully employed by the C.S.I.R.O. in the thermal processing of soft fruits such as strawberries, raspberries etc., in plain and pectinized syrups and also in canning of peaches.

(iv) It could be used with advantage in canning of heavy fruit syrups with maximum retention of flavour.

(v) It has been used at the C.S.I.R.O. as a useful aid in canning of 'cream rice' and 'Rice-

Pudding' which need stirring or agitation during their cooking.

(vi) Pressure spin-cooker-cooler could be used for high-temperature short-time (H.T.S.T.) processes for vegetables and other non-acid foods without any deleterious effect on the product under test.

Concluding Remarks

Spin-pasteurizer thus serves as a very useful piece of equipment adaptable for the efficient thermal processing of numerous food products. It has, therefore, undoubtedly a very bright future for its application in the preservation of various food products, particularly those in the Fruit Preservation Industry in India.

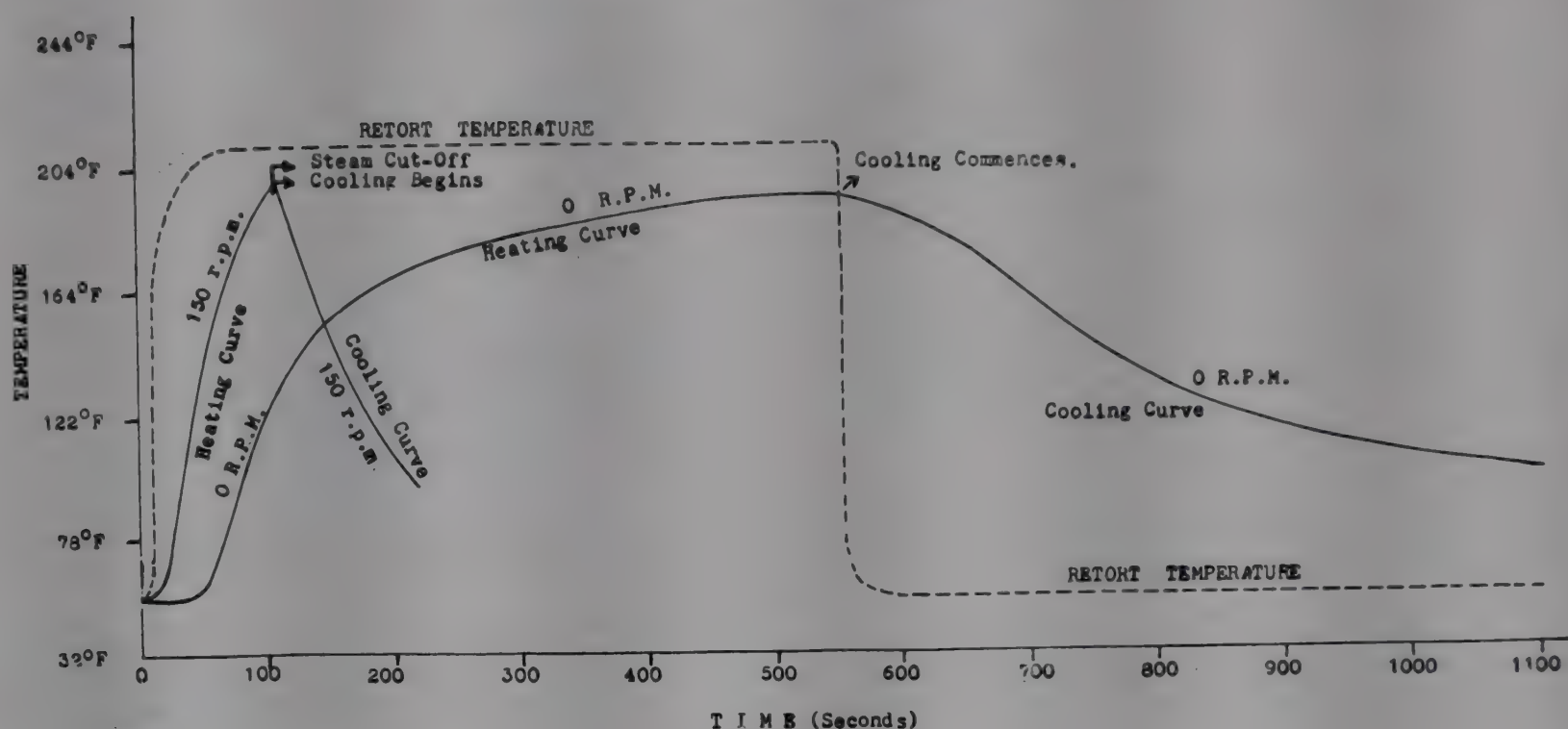
Summary

The paper deals with the working principle and performance of a new Spin-pasteurizer



PLATE: Pilot-plant (Batch-type) Spin-Pasteurizer being used for heat penetration measurements in canned citrus concentrates: (a) Pilot Plant Spin-Pasteurizer. (b) 'Speedomax' Recording Potentiometer. (c) Glass tube containing mercury and thermocouple wires. (d) Double-Pole-Double-Throw Switch.

FIG. Typical Heat Penetration Curves representing Comparative Heat Transfer during Stationary and Spin Heating-Cooling of Canned Lemon Concentrate (34°Brix).
(Container size = 202 × 214; Head-Space = $\frac{1}{4}$ ")



(agitating cooker) adaptable for the efficient thermal processing (Spin-pasteurization) of various types of fruit products. To illustrate its working, typical heat-penetration data collected by using suitable copper-constantan thermocouple wires and a 'Speedomax' recording potentiometer, on stationary and spin-pasteurization of canned water, single-strength lemon juice, four-fold and six-fold lemon concentrates are presented and discussed. Depending upon the nature of product, spin-processing takes one half to one tenth the time normally taken in the conventional stationary processing. The advantages, industrial applications and the future scope of the use of Spin-Pasteurizer in Fruit Preservation are also discussed.

Acknowledgement

Grateful acknowledgement is made to Dr J. R. Vickery, Chief of the Division and Mr L. J.

Lynch, Officer-in-charge, Canning Section, Division of Food Preservation and Transport, C.S.I.R.O., Australia, for the facilities provided and to the authorities of the Colombo Plan, the Director-General, C.S.I.R. (India) and the Director, C.F.T.R.I., for giving the author an opportunity to visit Australia.

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FOOD-GRAINS FROM TAPIOCA*

By V. SUBRAHMANYAN

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Tapioca is being grown in several tropical countries, both for industrial use and as an article of food. It is easy to raise, withstands a variety of adverse conditions and is at the same time a heavy yielder. Under favourable conditions, the yield can be as high as 20 tons per acre, whereas even on poor soils, a minimum of 2-3 tons can be expected i.e., under the worst of conditions also, tapioca can yield 3-4 times as much of starchy food per unit area as any grain crop.

The above must have been some of the considerations that led to the introduction of this crop, as an article of food, by a benevolent ruler of the former Travancore, now a part of the Kerala State. There is no doubt that the crop is extremely useful, especially in the dietary of the poorer sections of the people of the State. Even the richer people have developed a taste for the root, but it generally forms only a small part of their diet. Kerala has now over 500,000 acres under the crop and the production may be estimated to be not less than 1.5 million tons. The actual production may be even more because almost every house raises some quantity in the kitchen garden. So far as India is concerned, the concentration of the crop is mainly in Kerala. The total area in the rest of India may not exceed 50,000 acres. It has been established however, that almost every part of India can grow this crop and obtain good yields.

It has been reported by the Famine Commission that in 1943 the food-grain position in Travancore was even worse than in Bengal. In spite of this, no one died of absolute starvation in that State, whereas over a million people died in Bengal. It was tapioca that saved the people of Travancore.

In spite of these advantages, nutrition workers in different parts of the world have condemned tapioca as a major article of food. There is a very valid reason for this and it lies in the fact

that tapioca contains almost a negligible amount of protein, which is necessary for our growth and maintenance of good health. A pound of tapioca contains hardly 2 grams of protein, whereas we require about 70 grams per day. It would be practically impossible for any human being to eat 35 lb. of tapioca per day. Consumption of liberal quantities of milk, meat, fish and eggs helps to make up for the deficiency, but such protective foods are beyond the reach of a large section of our people. Because they cannot get them, people living predominantly on tapioca suffer from a variety of diseases. Liver diseases and wasting diseases of one kind or another are pretty common among them. Vulnerable groups, especially young, growing children and expectant and nursing mothers are particularly affected.

Our Government is concentrating a large part of its resources on increased production of food-grains. The country is today producing more food than ever before, but even that is steadily proving insufficient because of the very rapid increase in population at 5 to 6 millions a year. We have lately had some good seasons, but, if in any year, the monsoon fails, we will be very badly off. We can fill our stomachs by eating more tapioca but by doing so, our health will deteriorate. This will be particularly so in Kerala, which has a very heavy concentration of population, and has to depend on other parts of the country and also on other countries for meeting its deficiency of food-grains especially of rice.

With this background, it is logical to consider whether the abundant crop of tapioca can be suitably enriched with protein and converted into a form that could be cooked and consumed in the same way as any food-grain. If we can do so, we will be able to provide the people with large quantities of a food product of good nutritive value. The money will stay in the region and can be used for other development. The tapioca

* Script of the Radio Broadcast from the All-India Radio, Trivandrum, on 28th June 1957.

grower will also benefit because there will be a steady demand for his produce.

The researches conducted in the Central Food Technological Research Institute, Mysore, since 1949 have shown that Tapioca flour can be suitably enriched and fortified with specially prepared oil-seed meals. Unlike tapioca, these meals are exceptionally rich in protein. Thus, carefully prepared groundnut meal contains about 50 per cent protein against 0.5 per cent in tapioca. By suitable addition of oilseed meal, the protein content of the mixture can be raised even to a higher level than in any food-grain.

The first incorporation of such a type was done in 1950. After demonstrating the nutritive value of the mixture, the next step was to blend the composition in the form of a grain. In the early stages, only a round type of grain was made and the method of preparing it on a small scale was demonstrated in Trivandrum towards the end of 1950, at the All-India Exhibition held in that city. The usefulness of the product was generally appreciated by all who witnessed the process and sampled the products. It was then felt however that the shape may not appeal to the consumer. A suggestion was made that a product with the rice shape would be preferred by the consumer. The necessity for proper machinery for large-scale production was also indicated.

The Central Government, through the Ministry of Natural Resources and Scientific Research appointed an expert committee in 1952 to investigate the possibilities in the line. This committee, after very careful deliberation, came to the conclusion that there was a case for making such a product in the long-range interests of the country. The Director of the Central Food Technological Research Institute was deputed to Europe in 1953 to discuss the possibilities with experts in other countries and to select the type of machinery required for production on a reasonably big scale. The investigation took some months, but, ultimately, it was possible to secure the collaboration of a leading firm of Swiss manufacturers to design and fabrication took some time and it was only late in 1956 that the equipment could be received and set up in Mysore. Further trials and standardisation of working conditions took some more months and

the plant was ready for operation only in March 1957.

The unit at Mysore is not a big one, but it has a capacity of 1 ton per day (3 shifts) and that is sufficient not only to produce fair quantities, but also to conduct various types of trials, to ascertain consumer acceptance and, to some extent, even popularise the product.

The machine is largely automatic, one section of it is devoted to grinding, sifting and mixing the components. This is very efficient and every bit of material is so uniformly mixed that the resulting product is a fine, homogeneous flour. The next section involves the preparation of a dough with a limited amount of boiling water followed by extrusion of the dough, under high pressure, through a die followed by a cutting device. At this stage, the product emerges as a shower of rice which is then carried through a pre-drier to a continuous drier in which the material passes through a series of rotating drums. Finally, the product comes out as a dry grain that can be packed for despatch.

In this assembly, the extruding press is of the same type as used for the manufacture of macaroni products with which we are all familiar. By suitably changing the die any desired shape or size can be obtained. The consumer can, therefore, have a product not only with the rice shape, but certain other attractive forms like shells, tubes, letters, stars, etc. There can, therefore, be a large variety in the choice of the finished product though the composition will be the same.

At Mysore, the product has been made with different compositions. One composition contains about 60 per cent tapioca flour, 25 per cent wheat flour or semolina and 15 per cent of specially prepared groundnut flour. The finished product contains about 10 per cent protein besides adequate complements of other food accessories. The nutritive value of the product would correspond to roughly twice that of rice. This has been demonstrated not only through systematic animal experiments, but also human feeding trials.

Although the unit at Mysore is an experimental one and the tapioca has to be obtained from a long distance, the cost of the product would correspond roughly to Rs 560 per ton or about 25 nP per lb.

It can be reasonably expected that when made

on a big scale and right in the midst of the tapioca growing area, the cost will come down substantially and prove to be definitely cheaper than rice though nutritionally superior to it.

Between the 23rd and 24th of April 1957, some demonstrations of the use of the new product were arranged, with the kind co-operation of the Kerala Government, at Trivandrum. The demonstration attracted a fair amount of attention and the state authorities evinced keen interest in the development of the product.

The average consumer is naturally conservative especially in regard to the use of new food products. The people of Kerala are highly enlightened and it may be expected, that once the uses of the product are adequately demonstrated, they will not only show further interest, but also devise several new ways of using the product.

A rather remarkable feature of the new food product is that it is completely free from dust or dirt. The product requires no washing and in fact, it is not desirable to wash it because its cooking quality will then be adversely affected. For cooking the product, 6-8 times the volume of water should be first brought to boil and the product gradually added without disturbing the boiling. The cooking is very quick and is actu-

ally complete in 4-5 minutes. This is a great convenience and will save a lot of fuel to the housewife. At the same time, this involves a certain amount of watching because, otherwise, the product will get overcooked. It is, therefore, normally recommended that the gruel may be drained off when the product still feels a little hard. On subsequent standing, the cooking gets completed. In addition to the cooked grain, the gruel can also be used either as such or as admixed with other food preparations.

Since the first work was done at Food Research Institute, several other countries have shown keen interest in the development of similar products. Japan has also produced rice-shaped grain of a different composition. Other countries are using maize, potato or wheat. The principles are nearly the same. The object is to convert low-grade food materials into those of not only high nutritive value, but also of easy digestibility. It may take some years for the further popularisation and large-scale production of the new product but anyway, the efforts of Indian workers have shown the way for a new line of food processing that would be ultimately of great value not only to our own country, but also to others which are similarly placed.

SOME ASPECTS OF THE AUSTRALIAN FISH PROCESSING INDUSTRIES*

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Fish processing in Australia plays an important part in the country's economic structure. The supplies of fish and crustacea which go to make up an average annual catch of about 40,000 tons have been supplemented during the past six years by increasing quantities of prawns and by small supplies of tuna suitable for canning. Today there are 17 plants in Australia devoted exclusively to the fish canning.¹ A brief description of some aspects of the Australian fish processing industries is given below.

Smoking: Very little fish curing and smoking is carried out in Australia. The industry has languished over the years due to economic factors

and to the scarcity of regular supplies of suitable species. For example it has no cod, haddock, herring or hake which make up a large proportion of the fish smoked in Great Britain, the Continent and South Africa. In the past barracouta (*Thyrsites atun*) proved a good standby in the Southern States, but now there is such a demand for the fish in the fresh state that there is consequent increase in the price and thus fish smoking is not an economic possibility. One of the best smoked fish is produced from New Zealand blue cod imported into Australia. Tailor (*Pomatomus Pedica*), mullet and fish roes are also smoked in small quantities. Southern blue fin tuna (*Thun-*

* Notes on an overseas visit by the author as Senior Fellow (1955-56) under the Colombo Plan at the Division of Food Preservation and Transport, C.S.I.R.O., Australia.

mus maccoyii) could be used for smoking although the product will be dark in comparison with that produced from white fleshed species. Smoked tuna also should prove attractive as a speciality line and could be produced as a cold smoked or hot smoked product ready for eating.

In these days public demand is for slightly salted and lightly smoked products which require no pre-soaking to remove excess salt before cooking. Such products however, have a short life, not longer than a day or so under temperature conditions of 70°F or higher, but when packed in ice, the storage period may extend upto 10 days. For longer periods of holding it is necessary to make use of frozen storage.

Fish canning: Approximately 10 per cent of the fish caught in Australia are canned in factories in New South Wales, Tasmania, and Western Australia. The fish canning industry is based mainly on barracouta and Australian salmon (*Arripis trutta*) each accounting for about 40 per cent of the fish canned in Australia. Well equipped factories produce upto 20,000 cans (1 lb.) a day. These fishes are admittedly not of the best quality for canning but they are available at fairly low prices and also the canned products are readily consumed in the home markets. The tough texture of the salmon fish has been markedly improved by pre-brining the fish and the unattractive brown portions of flesh are changed to reddish pink by incorporating small amounts of nitrite in the brine.

Mullet, particularly the large oily sea-mullet (*Mugil dobula*) are suitable for canning but attempts made by several N.S.W. and Queensland canneries to introduce a canned mullet pack have not been successful. This has been partly due to the consumers' antipathy to the name mullet and partly to the cost of the raw materials and that of preparing the fish for canning. Estuarine mullet is not so suitable as the sea-mullet and sometimes the fish develop earthy flavours which depreciate the quality of the canned product.

Pilchards (*Sardinops neopilchardus*) are said to abound in many Australian waters, but only small quantities have been processed by West Australian canneries. The product is not of very high quality, which may be due to the fact that fish at the catching periods are of low oil content and

also in poor condition. A N.S.W. cannery erected several years ago has an up-to-date pilchard processing line which has never been used. These fish are the source of very large industries in some overseas countries. In South Africa, for example, the fish are available for 9 months to supply a catch of over 200,000 tons. About 10 per cent of this catch is canned and the rest is mostly used for the production of fish meal and fish oil. It is yet to be seen whether a large pilchard industry could be developed on similar lines in Australia.

Thus it is seen that the catching of small quantities of pilchards and that too at irregular intervals leads to comparatively high costs of the raw material and it is not likely to lead to a profitable pilchard canning industry.

The only other species canned to any appreciable extent in Australia is the Southern blue fin tuna at one N.S.W. cannery. At present, the quantity of fish available does not exceed 300-400 tons a year. The canned product is very good but rather expensive due to the low yields of product and high costs of processing. Tunas of other species are available all round the Australian coast. Thus the organization of the catching vessels and the setting up of canning factories would make a tremendous undertaking. Some blue fin tuna has been processed chiefly for export to England but this market has recently been lost due to the influx of much cheaper tuna from South America. The price at which the local product sells on the Australian market is too high to induce a good internal demand. One cannery in N.S.W. has handled small quantities of bonito (*Sarda australis*) which is an excellent canning species giving a high yield with the minimum cost of preparation. The Australian production of fish and fish products are shown in Table I.

Fish-pastes: Fish pastes are quite popular as sandwich spreads and are usually put up in glass jars or cans holding 2 ounces. Most of the fish paste produced in Australia is handled by one N.S.W. firm which uses a good deal of imported salmon and red herring together with some Australian species. A number of other canneries particularly during the war and for some years afterwards used the locally prepared heavily smoked barracouta for making fair quality

TABLE I. *Statistical data^a for fish and shell fish production in Australia for 1952-53**(Values expressed as metric tons)*

| Commodity | Production | Foreign trade | | Available supply |
|----------------------------------|------------|---------------|--------|------------------|
| | | Export | Import | |
| Fish fresh (Round weight) ... | 41,000 | 1,000 | 8,000 | 48,000 |
| Fish, canned | | | | |
| (i) Australian origin | 3,000 | ... | ... | 3,000 |
| (ii) Imported ... | ... | ... | 3,000 | 3,000 |
| Shell fish ... | 14,000 | 6,000 | ... | 8,000 |
| Cured (including salted) ... | ... | ... | 3,000 | 3,000 |

fish pastes. Pilchards or anchovies could also be used for this purpose. Being a small fish, less than 6 inches in length when mature and very tender-fleshed, the anchovy is very perishable by nature and presents many handling and processing difficulties. Moreover, by habit, the stomach and the very long intestine of the fish which is taken for processing are almost always full of feed—a greenish black material. Should this material be left in the fish in any quantity, the finished product is rendered very unsightly as a result of the stomach and intestinal contents being cooked and distributed in the form of a greenish scum over the finished product. It is, therefore, necessary to pay particular attention to the removal of gut. At one of the factories visited it was found that even the head and the gut could be incorporated in such pastes by suitably curing the fish in brine for a period of a few months.

Tuna chicken and tuna ham: An enterprising firm which is known as *Cee-Dee products Pty Ltd.*, Bermagui, has recently started preparing tuna ham and tuna chicken dispensing with the use of usual cans as containers for the finished product. The equipment of the factory consists mainly of steam cooking and smoking rooms, freezing chamber (600 c. ft.) and cold storage (1,700 c. ft.). When filled with fish, the temperature of the freezing chamber can be brought down to 0°F. in less than five hours and ultimately to -10°F. The frozen fish is stored in the cold storage at -5°F.

The initial processing plant can handle five tons of whole fish daily. After fish have been filleted, the meat which is to become tuna chicken goes through a special preliminary processing followed by steam-cooking in a retort. Cooking time is less than the usual precook for canning, and this is claimed to retain more of the original flavours of the tuna. After cooking, the 'chicken' is cooled, and then deep frozen.

The smoking of the ham is controlled by a system of air circulation and pressure, enabling accurate control of the process. The racks containing dressed and brined fish fillets are pushed into the smoke house where they are exposed to hot smoke at a temperature of 150°F., or higher for 2-3 hours, the distribution of smoke being facilitated by restricted ventilation at the floor level and in the ceiling. This treatment is sufficient to produce the desirable light tan colour and delicate smoke flavour. The products *viz.*, tuna chicken and tuna ham are packed in 28 lb. cartons lined with grease-proof paper, but may later be marketed in an individual cellophane pack. Both the products are solid meat with no waste, ready to serve as cold or for the preparation of hot dishes.

Shrimp Industry: Most of the prawn catch has been marketed locally as whole cooked and iced. Improved methods are being employed by the factories whereby time between catching the prawns and the storage of the cooked, cooled and packaged product is reduced to a minimum in refrigerated rooms with the result that the markets receive the product in the best possible condition. A beginning has recently been made of a substantial dollar export trade in frozen prawns to U.S.A.³. Arrangements have been completed to export the bulk of the supplies of banana prawn (*Penaeus merguensis*) to America as green tails. The prawns are intended to be exported as headless, green (uncooked) in four grades, ranging from 15-25 per lb. for the largest prawns and 40 for the smallest size.

Whale Processing: Whale flesh in small quantities has recently been processed by freezing for export to U.S.A. for use in the feeding of mink. The meat required to produce a good quality frozen product must be obtained in a fresh state and only certain muscles of the carcass are satisfactory for this purpose,

particularly when required for human consumption.

Shark flesh: In the Southern States of Australia, the flesh of certain small species of shark fish such as the snapper (*Chrysophrys auratus*) or school shark (*Galeorhinus rhinophanes*) and gummy shark (*Emissola antarctica*) is marketed in large quantities as a white fleshed fish. The iced and frozen fillets of these sharks when handled in the fresh state are freely accepted on these markets. If spoilage occurs, however, before reaching the consumer, the flesh develops ammonia which may render it inedible. Attempts have been made to produce canned packs of shark flesh from these species but, despite all attempts the product is not acceptable to the majority of consumers due to the off-flavours in the product.

Fish meal and fish liver oil as by-products: One of the leading fish canneries in N.S.W. is equipped with a small California Press Co., unit for fish meal production on a small-scale. The plant delivers 4-5 tons of fish meal containing 5-6 per cent moisture per 8 hours run. The equipment consists of a reducer with $1\frac{1}{2}$ " sieve perforations for use in hashing the raw fish, an elevator to convey hashed fish to the cooker, a screw-type pre-heater cooker, a screw type press for oil extraction, a reducer with fine sieves for grinding dried meal, and an elevator and cyclone to receive ground meal from the grinder. In addition, facilities are provided for the settling, centrifuging and storage of fish oil.

The shark liver oil industry was developed considerably during the war and is now an established industry. School shark yield a liver oil containing approximately 20,000 I.U. of vitamin A/g.

Application of refrigeration and frozen storage: Most Australian fish canneries have refrigeration including frozen storage space for holding the catch for periods longer than a few days which is the maximum for iced fish. Based on the recent work⁴ in Canada, some of the leading canneries have facilities for chilling fish in sea water at 29-30°F. whereby they can hold fish in this water for 7-8 days with better results than by conventional methods of icing.

Fair quantities of fish are being frozen rapidly in shallow containers on shelf coils. In this case the wrapped fillets or the whole or gutted fish are spread on trays in single layers on banks of refrigeration shelf coils. The equipment is less expensive and it allows reasonably fast rate of freezing at -10°F. In one or two modern factories concerned with the production of wrapped fillets, plate freezers of the Birdseye or Jackstone types are used. Blocks of 1 inch thickness of fish fillets can be frozen in 90 minutes and after removal and transfer to the card-board cartons are stored usually at -5°F. to -10°F. In two processing plants air freezing tunnels which are fairly expensive to construct, are in limited use and these have the advantage of flexibility for handling all shapes and sizes of fish and packaged fish. Cold air at -30°F. is circulated at a very high speed to freeze the fish.

Conclusion: Australia before the war proved a valuable market to foreign suppliers of canned fish experiencing the full blast of competition. Enlisting the aid of the Commonwealth Government with proper legislation to restrict imports of canned products, this important trade has considerably developed and flourished.

It can be safely said that Australia has invested appreciable capital in a major effort to develop the fishing industry. Outstanding advancements have been made in the processing, packaging and merchandising of their products. Unfortunately many canneries established during the war years are now closed. The successful ones have access to plentiful supplies of fish in most seasons and they also have facilities for storing large frozen quantities to provide for periods of scarcity. Australia's dependence on appreciable imports of canned, frozen and smoked fish to satisfy its own requirements does not appear likely to diminish until her own resources of pelagic species have been more effectively utilized.

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1. *Australian Fisheries*, Edited by I. G. MacInnes, Halstead Press Pty Ltd., Sydney, 1950.
2. *Food Balance Sheets* 1955, F.A.O. Rome.
3. *Fisheries Newsletter of Australia*, June 1956.
4. *Progress Report No. 95* of the Pacific Fisheries Experimental Station, July 1953.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during June 1957 are given below:

S (IS) 208 (155)

Proteins in foods—II, by S. Kuppuswamy, (June 22, 1957). Talking first of oilseeds and oilseed cakes, the speaker said that by reason of their availability in abundance and consequent cheapness, the potentialities of oilseeds as a source of protein are great. Their chief drawbacks are (a) some of them contain toxins and have to be detoxicated (e.g. gossypol in cottonseed); (b) their proteins with the exception of groundnut and linseed are sensitive to heat injury and (c) all of them are usually low in lysine. Groundnut protein, however, is deficient in methionine. Sesame and sun-flower seed proteins are by far richer in methionine than other plant proteins. Thus those plant proteins which are low in methionine e.g., soyabean and groundnut proteins can be fortified with sesame or sunflower seed proteins. Sesame and linseed proteins are also exceptionally rich in tryptophan. It has been recently reported that sunflower seed protein contains large amounts of several essential amino acids. Because of wide differences in the amino acid patterns of oilseed proteins (in contrast to legume proteins) mutual supplementation among them is possible.

Nuts are relatively costly and the proteins of some nuts like the pecan nut and the walnut have a low digestibility and only moderate biological value. Cashewnut protein, however, possesses a high biological value. Brazilnut protein is reported to be a rich source of methionine.

Fruits are not important protein sources in human diets. Banana protein has been reported to be well

balanced with respect to the essential amino acids. Tubers are generally low in protein some of which possess a high biological value.

Proceeding, the speaker pointed out that non-leafy vegetables, as a class, are minor sources of protein. The proteins of certain leafy vegetables like mustard greens, watercress, spinach and lettuce possess a remarkable supplementary value to the proteins of wheat and corn. Lucerne supplements the poor rice diet through its proteins, minerals and vitamins. Amaranth leaves are reported to be superior to the other leafy vegetables as a protein source for supplementing the proteins of cereals other than rice.

Chlorella as a source of protein has been much investigated in recent times, but there is not much enthusiasm for it as chlorella protein is only of average quality, and is deficient in methionine. Consumption of seaweeds is reported to adversely affect the utilization of even the proteins derived from the other constituents of the diet.

An interesting discussion followed in which attention was drawn to the unusually large amounts of certain essential amino acids, especially methionine reported to be present in sunflower seed proteins and it was agreed that these values require to be confirmed.

Winding up the discussion the President touched on the potentialities of isolated leaf and grass proteins in the human dietary and suggested that white clove, which possesses a comparatively mild flavour, is pre-eminently suited to processing as human food. He also suggested that it would be

worth making further attempts towards producing chlorella with a milder flavour.

S (IS) 209 (156)

Integrated processing of groundnut, S. S. Kalbag, (June 29, 1957). In continuation of a talk given earlier (vide *Bull. cent. Food. technol. Res. Inst.*, 1956, 5, 247), Dr S. S. Kalbag presented a paper on the bench-scale work on the integrated processing of groundnut carried out by a team of workers (S. S. Kalbag, N. Subramanian, K. E. Eapen, K. K. Gopalan and A. Balachandran).

He described the basic idea of the process as dispersing the groundnut kernel in water and then separating the three major constituents, oil, protein and starch-fibre on the basis of their difference in specific gravity. He also pointed out the similarity between this integrated process for extraction of protein and oil from the original kernel and the process for obtaining protein from fat-free cake.

He gave a short account of the work done in the laboratory and said that the results from the bench-scale work were somewhat different from those obtained in the laboratory. Extended trials were, therefore, conducted on batches of 100 lb. each in order to get complete data on the yields of the various products, to ascertain the reproducibility of results, and to anticipate the difficulties in the further development of the process.

The procedure followed was as follows: Groundnut kernel was given a light roast to remove the cuticle and was freed from all foreign matter. It was then ground in a dry state (3-5 per cent moisture) in

a 'Kek' mill to get a peanut butter type paste. Alkaline water was kneaded into this paste at 60-70°C., ('Skipin' Process) and at a critical moisture content and temperature, a large quantity of oil just oozes out. The liberated oil (30 per cent on weight of paste) was separated by draining. The residue was dispersed in water and the final pH adjusted to 10.0. The dispersion was passed through 40 mesh sieve to remove coarsely ground kernel (sieve residue) and then put through a horizontal imperforate basket centrifuge (Escher Wyss) to remove the suspended matter (carbohydrate meal). The clarified emulsion was passed through a hollow bowl high-speed separator centrifuge (Sharples Supercentrifuge) which separated the oil in the free state. The 'skimmed milk' was adjusted to pH 4.5 when the protein precipitated and this was separated from the whey by centrifuging. The sedimented protein was dried at 60°C. The yield of various products from 1,500 lb. of groundnut paste was as follows:

| | | |
|-----------------------------|-----------|-------|
| Oil ... Skipin | 450.6 lb. | |
| Separator | 180.3 | |
| Total | 631.0 | 42.1% |
| Protein | 340.8 | 22.6% |
| Carbohydrate Meal | 250.2 | 16.9% |
| Sieve Residue | 39.0 | 2.6% |
| Rotor bowl solids | 19.2 | 1.3% |
| Whey solids (not recovered) | 192.0 | 12.8% |
| Total | 98.3% | |

The speaker drew attention to the fact that two grades of oil were obtained—the Skipin oil with an F.F.A. of 0.2 per cent and separator oil with an F.F.A. of 0.05 per cent. The protein obtained had a high fat content, about 10 per cent. The oil balance showed, however, that if the separator efficiency could be increased, the yield of fat would increase and at the same time a low-fat protein would be obtained. The protein was tried in a local plywood factory as a substitute for casein in making the adhesive and was found to be satisfactory.

Concluding his talk Dr Kalbag said that the trials had established the reproducibility of the results within limits and also indicated the

importance of the two centrifuging operations in the process. In view of this he suggested that collaboration with a reputed centrifuge manufacturing firm would be very desirable, for further process development.

Dr Bhatia then gave a short account of the possible uses for the protein, and indicated the shortcomings in the present quality of the protein. This aspect required further study.

The President drew attention to the various difficulties one has to face in the development of a new process. He was hopeful that with further work the quality of the products, especially protein, could be improved.

The discussion that followed covered various aspects such as the unsaponifiable matter in the oil, nature of the carbohydrate fraction, destruction of lipase during roasting of groundnut, composition of whey solids, the efficiency of the separator and different possible methods of drying the protein.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Preparation of Brewer's yeast

E (S) 7291 (374)

Will you kindly inform me the details of the method of preparation of Brewer's yeast? (Sholapur Dist.)

The ground rye is first scalded with water of about 170°F temperature. Then it is stirred, the ground malt added and the whole mash kept for 2 hours at about 150°F. Its sugar content should be about 22-25 per cent. The mash is cooled to 120°F and kept for about 48 hours when complete souring takes place. Addition of

lactic acid bacteria helps to complete the souring in about 18 hours. The sour mash is filtered and the filtrate called wort is heated at 170°F for about 20 minutes to kill all the lactic acid bacteria and any undesirable organisms. It is then cooled to 85°F and the seed yeast is added. Fermentation commences and the yeast cells multiply. When the growth of yeast has reached the desired extent, the cells are separated in an equipment similar to the centrifugal cream separator. The heavy cream of separated yeast is cooled and further water is

removed by means of a filter press. The press cake is churned, squeezed in hydraulic presses, packed and stored in a refrigerator.

Sources of vitamin B₁₂

E (IS) 7291 (375)

Let me know the food materials which contain vitamin B₁₂. (Bombay)

The sources of vitamin B₁₂ are mainly of animal origin and no vegetable source has so far been known to contain the vitamin. The vitamin is present in liver and its preparation, eggs, fish muscle,

mutton and meat and milk. It is also produced as a by-product in the microbiological synthesis of aureomycin. Vitamin B₁₂ is a very costly product and it is being sold in the market at about Rs 1,200 per gram.

Quality of honey

E (IS) 7289 (376)

We shall be grateful if you can kindly suggest to us a simple test by which we can ascertain the quality of honey before purchasing. (Madras).

There is no simple test to ascertain the quality of honey except by the usual analysis of the sample. Genuine and pure honey contains 15-18 per cent water, 70-75 per cent invert sugars (about 35 per cent glucose and 40 per cent fructose) and from a trace to 5 per cent of sucrose. Honey is generally adulterated with cane sugar and corn syrup which are cheaply available. The presence of these can be detected by the usual analytical methods for the different sugars. Another method is to take the polarimeter reading. Genuine honey gives a levorotatory reading (i.e. turns the plane of polarised light to the left) while cane sugar and commercial glucose are dextrorotatory (turn the plane of polarised light to the right). Adulteration with invert sugar, however, is difficult to detect since the composition of invert sugar is similar to that of the sugars in honey.

Black-neck formation in tomato ketchup

E (F) 8998 (377)

What is the causative factor in the formation of black neck in tomato ketchup? How can this defect be controlled? (Bombay).

Black neck formation in tomato ketchup is distinguished from general browning of the tomato ketchup. In the former case, only a small portion near the top of the ketchup in the bottle becomes brown to black. This phenomenon is associated with an oxidative change due to the presence of

oxygen near the surface of the ketchup in the bottle and has been experimentally demonstrated to be so.

The role played by the individual spices has also been worked out. Since in black neck formation in tomato ketchup, tannins do play an important role, it is advisable to avoid the addition of dry spices as such. In the conventional method of making tomato ketchup, the spices are tied in a muslin cloth bag which is placed in the ketchup during boiling or a vinegar extract of the spices is added to the ketchup. In either case care is taken to avoid the incorporation of much tannins in the spice extract. Our work as well as the work carried out elsewhere indicate that oxygen is the most important factor responsible for the formation of tannin-iron complexes which result in the so-called black neck formation in tomato ketchup.

The oxygen in the headspace which causes the black-neck formation can be eliminated by the addition of ascorbic acid at the rate of 100 mg. per cent or addition of 100 p.p.m. of SO₂ in the form of potassium metabisulphite or by placing of an open tube containing alkaline pyrogallol to absorb the oxygen. The placing of tin or aluminium foil in the surface of the ketchup has a similar effect though to a lesser extent. Thus, filling the container with the hot ketchup, leaving as little headspace as possible at the time of filling, adding substances like ascorbic acid or sulphur dioxide to the bottle after filling it, using crown corks lined with tin or aluminium foil will be beneficial in overcoming the black-neck formation in bottled tomato ketchup. Of these, the addition of ascorbic acid is of additional significance on account of its nutritional value.

Banana dehydration equipment

E (F) 7409 (378)

Please give me a list of equipment required for the dehydration of bananas and the name of the firms which can supply them. (Poona).

Equipment required:

- (1) One preparation table, 8' × 3'.
- (2) One sulphur box—a closed box with (i) an inspection window through which the sulphur can also be burnt; (ii) arrangement for the supply of fresh air required for burning sulphur, as also for distribution of fumes of sulphur in the box; (iii) arrangement for the release of the residual sulphur dioxide fumes to the atmosphere after the fumigation operation;
- (3) A dehydrator, with thermostatic temperature controls and arrangements for recording of humidity and its control by suitable damper devices; with arrangement also for recirculation of a portion of hot air;
- (4) Drying trays (flat bottom) made out of bamboo strips fixed into wooden frames;
- (5) Storage bins for temporary storage of the dried product for equilibration of moisture before final packing and marketing;
- (6) An infra-red moisture testing outfit.

Except item No. 6 in the list of equipment above, which can be purchased from some dealer in scientific apparatus, other items have to be fabricated locally or in Bombay. Names of some of the firms who can undertake such fabrication work are given below:

1. M/s Armstrong Smith (P) Ltd., Gresham Assurance House, Sir Phirozeshah Mehta Road, P.O. Box No. 195, Bombay-1.
2. M/s Chemical Plant and Equipment Co., Calcutta.
3. M/s India Paper Machinery and Engineering Works Ltd., Calcutta.

Preparation and cost of mango leather

E (F) 5635 (379)

Which are the varieties of mango best suited for the preparation of mango leather? How much of sugar is to be added to the pulp and what would be the cost of production of the product? (Madras).

Broadly speaking, any variety of grafted or seedling mangoes can be used for the preparation of mango leather. The product from

different varieties will vary in carotene and ascorbic acid contents as well as in flavour. We have tested in this regard the varieties available in Mysore market *viz.*, Badami, Rasपुरi, Neelam, Seedlings, Mulgoa and Bangalora and found that they could be arranged in order of merit as given. We have no similar data on other varieties grown in Madras State or elsewhere.

In case of Badami and Rasपुरi pulps, it is not generally necessary to add any sugar, as the pulp itself is rich in sugars and is thus quite sweet or only slightly tart sometimes. The brix of these pulps is usually 18 to 20°. If the brix is lower than this, the pulp is rather tart as in case of seedling mangoes, sugar may be added to raise the brix to 18 to 20°. This may require the addition of about 5 per cent sugar.

Potassium metabisulphite may be added at 0.2 per cent level on weight of pulp to be dried.

Output in one operation, using 7 trays of 2 $\frac{3}{4}$ ' \times 2' will be approximately 16 to 20 lbs.

This year, the price of mangoes is abnormally high. At last year's retail rate of Rs 7-8-0 per 100 mangoes, the raw materials for 1 lb. of mango leather will cost about Re 1.12 on a home scale roughly, Re 0.38 per lb. may be added as an approximate cost of production, so that the total cost of production may be roughly taken as Re 1.50 per lb.

Moisture content in the final product should be about 15 to 20 per cent. This corresponds roughly to a drying ratio of about 4:1 or 5:1.

Preservation of sugar solution

E (F) 3896 (380)

Would you please tell me why potassium metabisulphite and citric

acid are added to the sugar solution used in the preparation of squashes, jams and jellies? (Vijayavada).

Sugar solutions are easily susceptible to fermentation.

(1) Syrups containing 66 per cent or more of sugar do not ordinarily ferment. However, in weak sugar solutions, one ounce of potassium metabisulphite is added per 100 lb. of the syrup to preserve it.

(2) In heavy syrups, there is a danger of crystallisation of sugar. Therefore, a portion of the sugar is inverted during the process of boiling by adding about half an ounce of citric acid per cwt. of the sugar used.

Preparation of fruit toffee

E (F) 9226 (381)

May I know the details of the method of preparation of fruit toffees? Kindly furnish the list of equipment required for a cottage scale unit with their approximate cost and the source from which I can get them. (Amraoti)

The different steps in the preparation of fruit toffees are as follows:

Preparation of fruit pulp. Pulp of the fruit to be used is first made. A stainless steel pulper with a 30 mesh screen may be used on a small factory scale for this purpose in the case of fruits like bananas, mangoes, jack fruit, etc. For preparation on a cottage scale, pulp may be prepared by crushing the peeled and prepared fruit and pressing it through a stainless steel or monel metal sieve.

Recipe: A general recipe is as under:

| | | | |
|----------------------------------|-----|-----|--------|
| Fruit pulp ... | ... | ... | 53 lb. |
| Sugar ... | ... | ... | 30 lb. |
| Glucose ... | ... | ... | 4 lb. |
| Skim milk powder ... | ... | ... | 8 lb. |
| Hydrogenated fat (vanaspati) ... | ... | ... | 5 lb. |

A suitable essence and colour, if desired.

Cooking. The fruit pulp is concentrated by evaporation in a steam jacketed kettle to about a third of its original volume, the other ingredients are then mixed up and cooking continued to a final weight equal to about 1-1/5 times that of the fruit pulp taken.

Cooling and setting. The cooked mass is transferred to a smooth, hard and level surface, preferably of a table with a stainless steel top, smeared lightly with fat. The flavouring material is added at this stage, if desired, and the product spread into a thin sheet of $\frac{1}{2}$ - $\frac{1}{4}$ cm. thickness and allowed to cool and set for two hours. The solid sheet is cut into toffees and dried at 50-55°C to a final moisture content of about 5-6 per cent, after which the toffees are wrapped as usual.

The equipment required for a cottage-scale unit of 25 to 50 lb. production capacity per day are given below:

| Name | Qty. | Approx. price Rs. |
|---|------|-------------------|
| 1. Aluminium kettles (15 lb.) ... | 3 | 20.00 |
| 2. Stainless steel or monel metal sieves of 12" diameter— | | |
| (1) 8 to 10 mesh ... | 1 | 70.00 |
| (2) 60 mesh ... | 1 | |
| 3. Stainless steel cooking pan (15 lb.) ... | 1 | 35.00 |
| 4. Coal furnace ... | 1 | 25.00 |
| 5. Aluminium trays (3' \times 1 $\frac{1}{2}$ ') ... | 6 | 75.00 |
| 6. Table knives ... | 2 | 5.00 |
| 7. Home drier with heating arrangement ... | 1 | 200.00 |
| 8. Wooden rollers ... | 1 | 2.50 |
| 9. Stainless steel scraper ... | 1 | 7.50 |

The addresses of various firms dealing in such equipment are given below:

- Messrs Gladwyn and Co., Powalla Building, 251, Hornby Road, Bombay.
- Messrs Gardners Corporation, 25/90, Connaught Circus, Post Box No. 299, New Delhi 1.

Notes and News

STATISTICAL NOTES

All-India Final Estimates of Major Millets (Jowar and Bajra, 1956-57)

| Crop | Area (thousand acres) | | Production (thousand tons) | |
|-----------|-----------------------------|---|-----------------------------|---|
| | 1956-57 (Final Estimate) | 1955-56 (Partially Revised Estimate) | 1956-57 (Final Estimate) | 1955-56 (Partially Revised Estimate) |
| Jowar ... | 41,314 | 42,904 | 7,427 | 6,602 |
| Bajra ... | 27,542 | 28,024 | 2,926 | 3,379 |
| Total ... | 68,856 | 70,928 | 10,353 | 9,981 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)

All-India Final Estimate of Tur (Arhar) 1956-57

| | 1956-57 (Final Estimate) | 1955-56 (Partially Revised Estimate) |
|--------------------------------|-----------------------------|---|
| Area (thousand acres) ... | 5,696 | 5,637 |
| Production (thousand tons) ... | 2,047 | 1,830 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)

All-India Final Estimate of Dry Chillies, 1956-57

| | 1956-57 (Final Estimate) | 1955-56 (Partially Revised Estimate) |
|--------------------------------|-----------------------------|---|
| Area (thousand acres) ... | 1,450 | 1,490 |
| Production (thousand tons) ... | 354 | 355 |

(Economic and Statistical Adviser, Ministry of Agriculture,
Government of India)

C.F.T.R.I. NEWS

The following distinguished persons visited the Institute during June—July, 1957.

20-6-1957: Prof. Bokuchava and a party of Russian Scientists, Academy of Sciences, Moscow.

27-6-1957: Dr Anna Mary Gade, Medical Officer, Senior Adviser, W.H.O., Bangalore.

1-7-1957: Mr B. S. Anand, Director, All-India Radio, New Delhi.

Mr T. S. Sodi, Central Leather Research Institute, Madras.

5-7-1957: Shri V. T. Krishnamachari, Vice-Chairman and Shri S. V. Ramamurthy, Regional Adviser, Planning Commission.

11-7-1957: Mr D. Javare Gowda, Controller of Examinations, University of Mysore.

Appointment:

Mr N. Rajasekharan has been appointed as Plant Chemist in the Synthetic Rice Plant Project.

Tapioca Macaroni Project:

At the invitation of the Kerala Government a team of the Staff of the Central Food Technological Research Institute has been transferred for a period of 6 months to undertake popularization of Tapioca Macaroni Rice in different parts of the State. Dr H. A. B. Parpia finalised the details of arrangement for the functioning of this team and organised a party in Trivandrum at which Legislators and the Senior Officers of the Kerala Government were served several sweet and savoury dishes prepared out of the Macaroni. The product was found acceptable by all. Dr V. Subrahmanyam, Director of the Institute, on a later occasion addressed the Legislators and explained the food value, low cost and other advantages of the product. The Macaroni Project Committee constituted for the development of this Project in Kerala recommended the immediate increase from 30 to 60 tons of the supply of Macaroni Products by C.F.T.R.I. The team will be touring the State to establish the



Gramsevikas demonstrating the cooking of Tapioca Macaroni at an N.E.S. Block in Kerala

consumer acceptability of the products. The Government of Kerala has decided to introduce it as a supplement to rice. The Government of India has undertaken to finance the establishment of the first Macaroni Manufacturing Plant in the State.

List of Papers Published

621. **Plan for the manufacture of Indian Multi-Purpose Food**, by Parpia, H.A.B., Swaminathan, M. and Subrahmanyam, V. *Food Sci.*, 1957, 6 (4), 96.

622. **Retention of added ascorbic acid in canned jack-fruit during processing and storage**, by Bhatia, B. S., Siddappa, G. S. and Lal, G., *Food Sci.*, 1957, 6 (5), 101.

623. **A simple method for assessing the extent of insect damage in commercial samples of stored grains**, by Venkat Rao, S., *et al.*, *Food Sci.*, 1957, 6 (5), 102.

624. **Good sanitation practices reduce cleaning time and improve bakery products**, Digested from *Baker's Review*, Nov. 1956, *Food Sci.*, 1957, 6 (5), 1957.

625. **Role of intestinal microflora in human health and nutrition**, by Subrahmanyam, V., *et al.*, *Food Sci.*, 1957, 6 (5), 104.

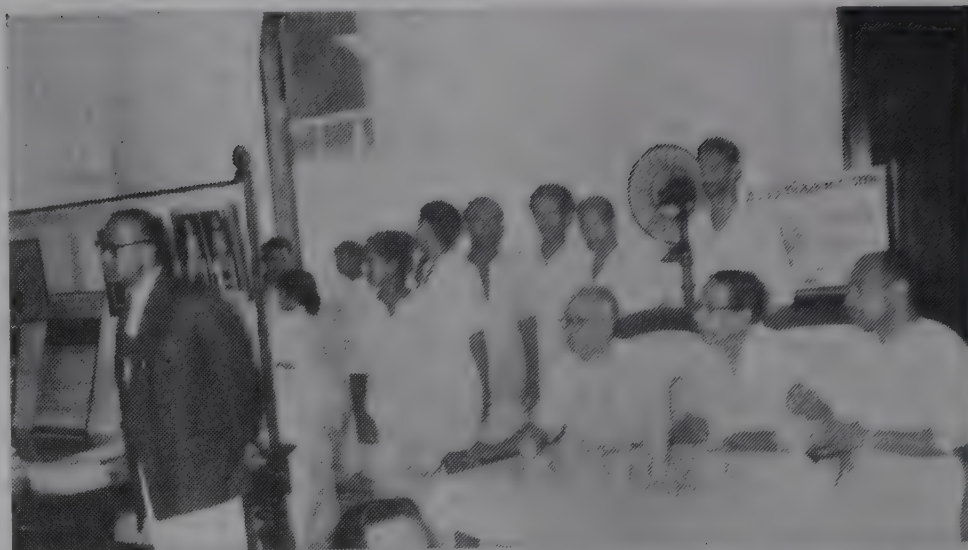
626. **Studies on the nutritive value of balanced malt foods**, by Chandrasekhara, M. R., *et al.*, *Indian J. Physiol. all. Sci.*, 1957, 11 (1), 28.

627. **Some problems and processes relating to the utilization of oils, oil-seed meals and oil-seed proteins**, by Subrahmanyam, V., *Indian Oilseeds J.*, 1957, 1 (3), 140.

628. **Development of alcohol extraction of oils**, by Raghunatha Rao, Y. K., *Indian Oilseeds J.*, 1957, 1 (3), 148.

629. **Stability of Vitamin B₁₂ in proteolysed liver extract**, by Sreenivasamurthy, V., Swaminathan, M. and Subrahmanyam, V., *J. sci. industr. Res.*, 1957, 16c, (4), 83.

630. **Paste goods industry in India—its place and prospects**, by Subrahmanyam, V., *Food Sci.*, 1957, 6 (6), 127.



Top: Dr V. Subrahmanyam, Director, C.F.T.R.I. addressing the Legislators of Kerala at Trivandrum.

Bottom: Shri K. C. George, Food Minister, Government of Kerala and other Legislators discussing the Macaroni Project with the Director and Officers of the C.F.T.R.I.

Additions to the Library

1. *Rice in Orissa*, 1956, by Chalam, G. V., (Dept. of Agri. Orissa), pp. 118, Rs 7-0-0.

2. *Technique of organic chemistry*, Vol. VII, 1955, by Weissberger, A. (Interscience), pp. 552, \$ 8.50.

3. *Analysis of insecticides and acaricides*, 1955, by Gunther, F. A. and Blinn, R. C., (Interscience), pp. 706, \$ 14.00.

4. *Biochemistry of the amino-sugars*, 1955, by Kent, P. W., and Whitehouse, M. W., (Butterworth), pp. 311, £ 2-0-0.

5. *Structural chemistry of proteins*, 1954, by Springall, H. D., (Butterworth), pp. 376, £ 2-5-0.

6. *Tea manufacture in Ceylon*, 1956, by Keegel, E. L., (Tea Res. Inst., Ceylon), pp. 163, Rs 5-0-0.

7. *Enzymes, units of biological structure and function*, 1956, by Gaebler, O. H., (Academic. Pr), pp. 624, \$ 12.00.

8. *Chemical engineering practice*, Vol. I, 1956, by Cremer, H. W., and Davies, T., (Butterworth), pp. 494, Rs 71-4-0.

9. *Industrial fermentations*, Vol. II, 1954, by Underkofler, L. A., and Hickey, R. J., (Chemical Pub. Co. N.Y.), pp. 587, \$ 12.00.

10. *General of fungi*, 1954, by Clements, F. E., and Shear, C. L., (Hafner, N. Y.), pp. 496, \$ 15.00.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

Biological and chemical estimation of vitamin D in shark liver oil, by Pradhan, S. K. and Magar, N. G., *Indian J. Med. Res.*, 1957, **45** (1), 49.—Liver oils from different species of sharks, khada, pitori, waghbeer and win, and from two other fishes not belonging to the class elasmobranchii, viz., dara and ghol, were examined for their vitamin D contents, biologically and chemically in case of sharks and only chemically in case of dara and ghol. Shark liver oils contained only 5 to 15 I.U. of vitamin D. Chemical method could not be satisfactorily applied for the estimation of vitamin D in shark liver oils.

M.S.

BIOCHEMISTRY AND NUTRITION

Effect of ionising radiation on the nitrogen excretion in urine of albino rats, by Das, P. N., Dutta, J. and Mukherjee, K., *Sci. & Cult.*, 1957, **22** (12), 691.—Earlier workers have reported an increase in the total urinary nitrogen excretion in albino rats following irradiation believed to be due to increased protein destruction in the tissue. The AA have investigated into the nature of this increase in the nitrogen excretion by exposing three albino rats kept on control diet to whole body radiation of $(200 \pm 30)r$ using a radium source. Twentyfour hour urine samples were collected and total nitrogen as well as total solid excreted were estimated. The total urinary nitrogen excretion following irradiation showed a considerable decrease within 24 hours, which is maintained for 2 to 3 days. After this period, it

increased and remained like that till the end of the 5th week after irradiation. Chromatographic analysis of the urine showed considerable increase in the amounts of several amino acids of which glycine, taurine, glutamic acid and alanine are very significant.

K.L.R.

Alkaline phosphatase and succinic dehydrogenase activity of rat kidney in maleic acid toxicity, by Bharadwaj, T. P., *Curr. Sci.*, 1957, **26** (6), 179.—Amino-aciduria, phosphaturia and glycosuria have been produced in albino rats by injection of maleic acid and this has been attributed by earlier workers to be due to the absence of alkaline phosphatase in the proximal tubule of the kidneys. To ascertain the validity of this theory, the A has carried out histochemical investigations with rats for the alkaline phosphatase and succinic dehydrogenase activity on the kidney after administering maleic acid. Albino rats were kept on rachitogenic diet for 6 weeks and then glucose, phosphate and amino acid contents in the daily urine samples were determined for three consecutive days. The rats were then given an injection of buffered maleic acid intraperitoneally. Urine samples were again tested when gross amounts of glucose, phosphate and amino acids were found. The animals were sacrificed at this stage and histochemical staining of the kidney sections for the enzyme activity were carried out. No quantitative diminution of the intensity of histochemical staining of the two enzymes was observed thus indicating that absence of alkaline phosphatase in the proxi-

mal tubule of the kidneys may not be an essential prerequisite for amino-aciduria, phosphaturia and glycosuria.

K.L.R.

Oxidative enzymes and phosphatases in *Agave vera cruz* Mill., by Nagabhushanam, A., Srinivasan, K. S. and Srinivasan, M., *J. sci. industr. Res.*, 1957, **16C** (6), 127.—Peroxidase, catalase and phosphomonoesterase, present in the stem of *Agave vera cruz* Mill. have been studied. Partial purifications by fractional precipitation with ammonium sulphate and dialysis results in a 30-fold increase in peroxidase activity, but only in a 2-fold increase in phosphomonoesterase activity, on protein basis. The latter enzyme shows two pH optima, one around pH 3.5 and the other around pH 5.5. Magnesium did not have any activating effect on either of the acid phosphatases.

Heat stability of fungal α -amylase, by Durlav Roy, K., *Ann. Biochem. exptl. Med.* 1956, **16** (2), 111.—Crystalline fungal α -amylase deteriorates rapidly above 40°C and is completely inactivated at 55°C . Crude amylase is comparatively stable to heat, its temperature of inactivation being 10°C higher than that of the crystalline material.

M.S.

Studies in experimental diabetes. Part V. Effect of treatment with vitamin E and vitamin K and their combination with oestrogen on the course of alloxan diabetes in rats, by Mukherjee, S. K., De, U.N. and Mukerji, B., *Indian J. med. Res.*, 1957, **45** (1), 23.—Diabetic rats with hyperglycemia below 300 mg. per cent with 7 days of alloxan

administration show a tendency towards spontaneous recovery: on the other hand, rats whose blood sugar reaches 300 mg. per cent or above within 5 to 7 days after alloxan becomes permanently diabetic. The results of the five types of treatment show that combination of vitamin K and oestrogen is the most effective and the combination of vitamin E and oestrogen is the least effective. When administered separately oestrogen has been found to be more effective in the treatment of alloxan diabetic rats than either vitamin K or vitamin E.

M.S.

Studies on the nitrogenous constituents of urine in normal subjects and in patients suffering from cirrhosis of liver, subacute nephritis and hypertension, by Pain, S. K. and Banerjee, S., *Indian J. med. Res.*, 1957, 45 (1), 35.—Total N, urea N, ammonia N, amino acid N, creatinine, creatine and uric acid were estimated in the urine of 50 normal subjects, 25 patients suffering from cirrhosis of liver and sub-acute nephritis, and 20 patients suffering from hypertension, respectively. Cirrhotic patients excreted in their urine more amino acid N and ammonia N and lesser amounts of other nitrogenous constituents than normal subjects. They also excreted creatine in urine which was absent in the urine of normal persons and of other patients studied. Patients suffering from sub-acute nephritis excreted albumin in urine. While they excreted more amino acid N, the excretion of other nitrogenous constituents in urine was greatly diminished. Hypertensive patients excreted albumin in urine. All the nitrogenous constituents of urine were low possibly due to renal failure.

M.S.

Effect of continued feeding of curds on the intestinal flora and biosynthesis of thiamine in rats, by Balakrishnan, S., Baliga, B. R. and Rajagopalan, R., *Indian J. med. Res.*, 1957, 45 (1), 56.—The effect of continued feeding of curds as

against feeding synthetic thiamine along with sulfaguanidine administered in alternate weeks on the biosynthesis of thiamine was studied. Where curds were fed throughout the experiment, no significant reduction in thiamine synthesis or the number of coliform bacteria was produced by the administration of sulfaguanidine in alternate weeks, an alternate rise and fall in thiamine synthesis was observed in the initial stages, but later there was no appreciable reduction in the synthesis of thiamine or the number of coliform bacteria, suggesting thereby that the antagonistic effect of curds towards the action of the sulfa-drugs was persistent after some time. Under conditions of synthetic thiamine feeding, sulfaguanidine brought about a drastic reduction in the synthesis of thiamine followed by a considerable fall in the body-weight of animals. Some animals of this group died before the close of the experiment.

M.S.

FISH

Studies on the curing and preservation of 'Choodai'. I. Some aspects of dry salting, by Krishna Pillai, V., Valsan, A. P. and Rajendranathan Nayar, M., *Indian J. Fish.*, 1957, 4 (1), 32.—The paper deals with the studies conducted on different aspects of curing of sardines. Data have been presented on the changes in the moisture and total volatile nitrogen contents of the fish during drying in the sun for different periods under different experimental conditions. It is observed that in sun-dried sardines the moisture content of the fish has to be kept below 25 per cent in order that it may keep for a sufficiently long period without undergoing spoilage.

The rate of penetration of salt in the case of *S. gibbosa* and *S. albella* at different intervals during dry-salting with different proportions of salt was studied. It is observed that, under normal conditions, optimum salt penetration takes place within 20 hours in the case of the former and 26 hours in the

case of the latter when salt is used in the proportion of 1:3 to 1:6. With less amount of salt the period of salting is found to increase. It is further observed that the T.V.N. values of these samples kept for long periods for salting are found to be comparatively very high.

In cases where pressure is applied on the fish while salting, the period required for optimum salt penetration is found to be less, thus minimising the changes of too much spoilage during salting. The water from the fish is squeezed out quickly when pressure is applied and this probably helps in quicker and uniform curing.

The T. V. N. and peroxide values of the stored samples were estimated at monthly intervals. The results indicate that when a sufficiently high proportion of salt, up to 1:6 by weight of fresh fish, is used the increase in the T. V. N. values is comparatively small.

A comparative study of the proteins of shark and skate and casein I. Isolation, analysis and comparison of amino acid make-up, by Ambe, K. S. and Kamala Sohoni, *Indian J. Fish.*, 1957, 4 (1), 113.—The isolation of proteins from shark and skate muscle has been effected and the proteins have been compared with a standard protein like casein.

Studies on the extraction of nitrogen by solvents like water, saline, aqueous ethanol and dilute alkali reveal that the fishes contain the maximum amount of alkali-soluble nitrogen, while the salt-soluble, water-soluble and alcohol-soluble fractions get dissolved in decreasing proportions.

A method of preparation of the total proteins has been described consisting of the extraction of the proteins with dilute alkali and precipitation of the same with acetic acid. The process is very promising, the product obtained being of a light yellow colour and almost free from the fishy odour. The yield is about 10 g. /100 g. of fresh fish muscle.

Studies on the distribution of nitrogen indicate a high percentage

of the basic amino acid fraction in the fish proteins. The percentage of nitrogen due to humin is higher while that due to ammonia is of the same order as in the casein.

A semi-quantitative comparison of the amino acid make-up of the fish proteins and casein has been effected by the paper chromatographic method. The fish proteins are found to compare very favourably with the standard casein in this respect. The amounts of proline and tyrosine are correspondingly higher in the casein whereas the proteins prepared are richer in cystine, arginine, lysine and alanine contents.

A comparative study of the proteins of shark and skate and casein II. Enzymic hydrolysis of the fish proteins and casein, by Ambe, K. S. and Kamala Sohnie, *Indian J. Fish.*, 1957, 4 (1), 124.—The AA have made a comparative study of the action of two proteolytic enzymes, *viz.*, pepsin and trypsin on the proteins of shark and skate and casein. The total digestible nitrogen when hydrolysed by pepsin, the rate of hydrolysis of the proteins under the influence of trypsin and the order in which the amino acid are liberated during the tryptic digestion have been determined. The results show that all the proteins are very easily hydrolysed almost completely by pepsin and the soluble nitrogen content in the case of fish proteins is slightly higher than in the case of casein. The rate of hydrolysis by trypsin at different intervals reveals that casein is much more quickly hydrolysed and the digestion reaches its maximum earlier than in the case of fish proteins. The order of liberation of the amino acids due to the degradation of the protein by trypsin has been studied by a paper chromatographic analysis of the hydrolysate at successive intervals of time. The bands are identified with a standard chromatogram for amino acids. It is found that there is a considerable difference between the fish proteins and casein in the order of liberation of amino acids due to hydrolysis by trypsin.

K.L.R.

A comparative study of the proteins of shark and skate and casein III. Essential amino acid content and the nutritive value, by Ambe, K. S. and Kamala Sohnie, *Indian J. Fish.*, 1957, 4 (1), 130.—The essential amino acids in the proteins of shark and skate have been estimated by standard microbiological procedures with a view to assessing their nutritive value. The results have been compared with those for casein and whole egg protein. The fish proteins contain a very good proportion of all the essential amino acids, and there is not much difference in the composition of the shark and skate proteins, except that shark protein contains more of lysine and less of threonine as compared to skate protein. When compared with casein, the fish proteins are considerably richer in lysine, arginine and cystine, while casein is superior to the other two as far as histidine, phenylalanine and valine are concerned. The protein of whole egg is found to be richer than the fish proteins in many amino acids although the latter are a richer source of arginine and lysine. The biological values calculated from the concentrations of the essential amino acids are 89, 84 and 77 respectively for shark and skate proteins and casein, thus showing the superiority of the fish proteins over casein. The fish proteins being particularly rich in lysine, arginine and cystine can be of very great importance for supplementing the deficient food proteins. Besides serving as a supplementary food, the fish protein hydrolysates can be extensively used in dietetics and clinics to cure various disorders requiring a high level of protein nutrition.

K.L.R.

MICROBIOLOGY

Effect of temperature on the growth and sporulation of the two strains of *Fusarium coceruleum*, by Agarwal, G. P., *Sci. & Cult.*, 1957, 22 (12), 687.—Two strains of *Fusarium coceruleum* causing dry rot have been isolated respectively from potato and *Colacasia antiquorum*. The present note deals

with the effect of temperature on the dry weight and sporulation of the two strains and also their thermal death point. It was found that the strain isolated from potato was killed at 45°C in 10 minutes, 46°C in 5 minutes and 47°C in 2 minutes while that from *Colacasia* showed some difference and was killed at 46°C in 10 minutes, 47°C in 5 minutes and 48°C in 2 minutes. The dry weight and sporulation of the two organisms have been studied at various temperatures between 8°C and 36°C. The results show that at 8°C, the organisms did not grow. There was slight growth at 12°C and at 24°C, maximum dry weight as well as best sporulation were observed. With further increase in temperature there was a decrease in the dry weight and in the rate of sporulation. At 36°C, the two strains failed to show any growth. The above findings indicate that it will be best to store the potato tubers and *Colacasia* at about 12°C or below.

K.L.R.

OILS AND FATS

Studies on iso-oleic acids: Part V—Iso-oleic acids of beef-body and cow-butter fats, by Subbaram, M. R. and Mahadevan, A. P.,—*J. sci. industr. Res.*, 1957, 16C (6), 130—Quantitative separation and estimation of the iso-oleic acid fractions of beef-body and cow-butter fats have been carried out employing partition chromatography. The procedure recommended for the preparation of vaccenic acid from these two fats does not give a homogeneous substance.

GENERAL

Improvements in parboiling of paddy, by Desikachar, H. S. R. Laxminarayana, S. K., and Subrahmanyam, V., *Res. & Ind.*, 1957, 2 (6), 150.—The main drawback of parboiled rice commercially produced is its undesirable off-flavour caused by the fermentation of paddy during the soaking process. Fermentation also reduces the nutritive value of the rice. The defects

in the cold and hot soaking processes for parboiling of paddy in current use are given. The use of sodium hypochlorite at a prescribed level to the soak water in the cold soaking process prevents the fermentation of the paddy. However, in actual practice, there is always the risk of using the chemical much in excess of the prescribed level. In the hot soaking process, the temperature of soak water is about 45° and this is insufficient to prevent the fermentation causing off-flavour. The use of a high soaking temperature (65-75°C) prevents this fermentation

completely and also reduces the soaking time from 24 hours to 3-4 hours. Based on this principle, the method of hot soaking has been standardised after large scale trials of commercial parboiling without effecting any major change in the existing equipment and facilities available in parboiling mills. The details of the standardised method are given. The main advantages of the standardised method over the existing methods of cold soaking and hot soaking at about 45°C are: (1) the high soaking temperature (70°C), and the short soaking

period for 3-4 hours completely inhibit the growth of microflora thus eliminating the fermentation and bad smell, (2) the entire batch of paddy can be soaked, steamed and dried in a single day and (3) because the soaking and subsequent steaming are carried out in the same tank, there is a saving in labour costs. The need for laying down standards for parboiled rice particularly with respect to the moisture content, with a view to improve the quality of rice has been stressed.

K.L.R.

PART II (Foreign)

ANALYTICAL

Determination of carotene in silages and forages, by Wiseman, H. G., Irvin, H. M. and Moore, L. A., *J. agric. Fd. Chem.*, 1957, 5 (2), 134.—A rapid chromatographic method for the determination of carotene in silages and forages is described. Necessary conditions for separation of carotene from impurities on magnesium oxide—Celite columns in the presence of small amounts of alcohol have been established. The analysis combines the advantages of splash-free blending extraction afforded by alcohol-Skellysolve B foaming mixtures and the elimination of epiphasic washing to remove alcohol. Additional advantages include faster and more compact elutions gained by the presence of alcohol of the column. Direct collections in smaller volume eliminate concentration and transfer operations.

The use of an anion-exchange resin in the determination of traces of lead in food, by Johnson, E. I. and Polhill, R. D. A., *Analyst*, 1957, 82, 238.—Microgram amounts of lead are separated from most other ions by absorption from N. hydrochloric acid solution on a column of the chloride form of an anion-exchange resin. The lead is recovered by elution with 0.01 N hydrochloric acid. This principle is used in a method for the determination of lead in foods.

BIOCHEMISTRY AND NUTRITION

Lysine, threonine and other amino acids as supplements to rice diets in man: Amino acid imbalance, by Hundley, J. M., *et al.*, *Amer. J. clin. Nutr.*, 1957, 5 (3), 316.—The nitrogen balance technic was used in five normal young adult males to evaluate certain amino acids as supplements in rice diets. Rice (250 or 350 g.), fat (100 g.), fruit, and sugar were used to prepare constant diets providing 26 to 31.7 g. protein and 2,800 to 3,500 calories (39 to 50 cal/kg. body wt.).

Lysine alone induced a positive shift in N balance in one subject. Threonine alone was ineffective. Lysine and threonine together had a highly significant positive effect in one subject, questionably positive effects in two others, no effect in a fourth, and a highly significant negative effect on nitrogen balance in a fifth subject. The addition of methionine resulted in a positive shift in N balance in the subject who failed to respond to threonine and lysine alone. In another test the threonine, lysine, and methionine mixture did not improve the response beyond that produced by threonine and lysine alone. A mixture of threonine, lysine, and histidine produced a positive response in one trial. Mixtures of the eight essential amino acids resulted

in positive shifts in two trials. In a third trial the response was significantly negative. A mixture of non-essential amino acids produced positive effects approximately equal to that with the eight essential amino acids.

These results are interpreted as indicating that a primary deficiency in these diets is that of available nitrogen, essential or non-essential. The positive effects of the amino acid supplements are interpreted as being due in part to the nitrogen supplied. Lysine, and perhaps methionine, seemed to exert a 'specific' effect in improving protein utilization over and above their nitrogen contribution in some, but not all subjects. No evidence for a similar effect of threonine or other amino acids was obtained.

The highly significant negative response to lysine plus threonine in one subject and to a mixture of the eight essential amino acids in another is interpreted as providing evidence for the importance of amino acid balance in man.

CEREALS

Application of the Karl Fischer method to grain moisture determination, by Hart, J. R., and Neustadt, M. H., *Cereal Chem.*, 1957, 34 (1), 26.—A method has been developed for determining moisture in grain which involves the simultaneous grinding of the

grain and extraction of the water with methanol, and subsequent titration of the extract with Karl Fischer reagent. Results were in good agreement with those obtained with official oven methods for wheat, oats, barley, rice, and rye, but were somewhat lower than oven method results for soyabeans and flaxseed and somewhat higher for pea beans and corn. Volatile substances other than water are removed in the heating of soyabeans and flaxseed which give higher moisture values by the oven method, and in the case of corn and pea beans not all of the water is removed by the water-oven method. Essentially all of the water is extracted from the grain by the new method and the extracts contain no appreciable amount of material other than water which will react with the Karl Fischer reagent.

Studies on corn proteins, I.—A new method of extraction, by Mertz, E. T. and Bressani, R., *Cereal Chem.*, 1957, 34 (1), 63.—The proteins of corn germ and corn endosperm can be rapidly and almost completely extracted by an alkaline medium containing sodium, copper, sulfate, and sulfite ions. The ions are removed by dialysis or isoelectric precipitation. In this method the residual nitrogen insoluble in alkali is dissolved by the joint action of copper and sulfite ions.

FRUIT AND VEGETABLE PRODUCTS

Nutrients in Central American beans, by Tandon, O. B., *et al.*, *J. agric. Fd. Chem.*, 1957, 5 (2), 137.—Because of the special nutritional importance of beans in Central America and Panama, the factors influencing protein, methionine, lysine, and tryptophan content of 25 varieties were studied. Niacin, thiamine, and riboflavin were also determined. Over-all differences in nitrogen and tryptophan content among varieties and between localities were highly significant. The fertility of the land significantly alters the yield and riboflavin content of the kidney

bean, but the content of nitrogen, methionine, lysine, tryptophan, niacin, and thiamine is not detectably affected by fertility differences.

Use of the jacketed room system for cool storage, by Lentz, C. P. and Rooke, E. A., *Food Technol.*, 1957, 11 (5), 257.—The authors have distinctly shown the advantages of a jacketed room system for cool storage of fruits and vegetables. Making use of cenery, they have produced factual data indicating the reduction in the loss of moisture and prolongation of storage life. The advantage of this system is that there is no direct exposure of the stored material to the refrigeration coils and hence there is tremendous reduction in the moisture loss from the stored food. Thus the reduction in the deterioration of stored Fruits or vegetables should be of commercial advantage to the cold storage plants if they could make use of this system.

H.A.B.P.

Changes in light reflectance and ascorbic acid content of foods during frozen storage, by N. B. Guerrant, *J. agric. Fd. Chem.*, 1957, 5(3), 207.—Reflection measurements and ascorbic acid determinations were taken with certain vegetables stored at 10°, 0° and -10°F for 12 months. Storage temperature had a very definite effect on the above factors, changes being greatest at higher temperatures. Changes in the reflectances of foods during frozen storage seem to parallel changes in ascorbic acid content. Asparagus being relatively deficient in plant pigments, underwent no great change in reflectance. Green beans, broccoli and spinach underwent greatest changes in the green-yellow region. Peaches and Strawberries had great change in orange-red region. The retention of ascorbic acid is 80 to 100 per cent at -20°F storage, considerably less at 0°F and negligibly small at 10°F. Those samples which changed most in reflectance also decreased most in ascorbic acid content.

G.V.K.

MEAT PRODUCTS

Deterioration of dehydrated meat during storage, I.—Non-Enzymic deterioration in absence of oxygen at tropical temperatures, by Sharp, J. G., *J. Sci. Fd. Agric.*, 1957, 8 (1), 14.—The deterioration in quality of dehydrated precooked pork which takes place during storage even in the absence of oxygen would appear to be due to a typical carbonyl-amino browning reaction. The effects of moisture content and temperature on the changes have been studied. The reactive sugar fraction in meat consists mainly of free glucose and glucose-6-phosphate. Although the sugar fraction produces a brown discolouration by reaction with either the protein fraction or non-protein soluble fraction, the characteristic bitter, burnt flavours of stored dehydrated meat are produced only by reaction with the non-protein fraction.

The reaction can be inhibited entirely by storage in nitrogen containing 500 p.p.m. of sulphur dioxide or by removal of the reducing sugar and glucose-6-phosphate by fermentation with high concentrations of yeast. Partial inhibition is achieved by fermentation of the free sugars only, by lower concentrations of yeast or by oxidation of the free glucose only, by glucose oxidase.

Deterioration of dehydrated meat during storage, II.—Effect of pH and temperature on browning changes in dehydrated aqueous extracts, by Sharp, J. G., *J. Sci. Fd. Agric.*, 1957, 8 (1), 21.—The rate of development of brown discoloration in dehydrated aqueous extracts of meat has been shown to increase with pH over the range 3 to 7.

The Q_{10} of the rates of loss of free sugar and development of brown discoloration in such extracts during storage in the range 15° to 50° are the same and lie between 3.2 and 4.3.

MICROBIOLOGY

Concentration effects in the enzymatic conversion of lactose

to oligosaccharides, by Roberts, H. R. and Pettinati, J. D., *J. agric. Fd. Chem.*, 1957, 5 (2), 130.—A study was made of hydrolyzing conditions conducive to high oligosaccharide yields by the action of *Saccharomyces fragilis* lactase on lactose. With pH, temperature, and enzyme concentration held constant, lactose substrates from 5 to 50 per cent were hydrolyzed. The percentage of lactose converted to oligosaccharides increased as the starting lactose concentration increased. This relationship held up to a limiting lactose concentration of 35 per cent (w./v.), at which a maximum conversion of 44.6 per cent was obtained. At starting lactose concentrations of 22 to 50 per cent, the quantity of oligosaccharides present (at the time at which the oligosaccharide concentration reached a maximum value) was linearly related to the sum of the galactose and glucose concentrations as well as to the starting substrate concentration.

The influence of temperature on the generation time of bacteria commonly found in milk, by Yotis, W. and Teodoro, R., *J. Dairy Res.*, 1957, 24 (1), 27.—An attempt to show the effect of temperature on the rate of growth of bacteria in milk was made by finding the generation times of *Salmonella typhosa*, *Shigella dysenteriae*, *Streptococcus haemolyticus*, *Micrococcus pyogenes aureus*, *Lactobacillus acidophilus*, *Escherichia coli*, *Bacillus subtilis* and *Alcaligenes faecalis* at temperatures ranging from 4 to 60°C. Growth was quantitatively measured by means of plate counts during the logarithmic period which was previously determined for each organism. The following is a summary of the results obtained:

At 4°C. none of the micro-organisms showed evidence of multiplication during the 6 hr. incubation.

As temperatures of 5-45°C. were approached the generation time decreased until the optimum temperature for each organism was reached; beyond this point a slowing of growth was observed, until

at 60°C. viability was apparently lost by all the organisms.

Streptococcus haemolyticus and *Micrococcus pyogenes aureus* have a generation time of 37-23 min.

Salmonella typhosa and *Shigella dysenteriae* have a generation time of 50-26 min.

Escherichia coli and *Alcaligenes faecalis* have a generation time of 41-16 min.

Bacillus subtilis grows at about the same rate as *Alcaligenes faecalis*.

The slowest organism of all appears to be *Lactobacillus acidophilus* with a generation time of 52-125 min.

OILS AND FATS

The use of differential curves in the dilatometry of fats, by Jasperson, H. and McKerrigan, A. A., *J. Sci. Fd. Agric.*, 1957, 8 (1), 46.—Differential dilatometric curves, in which the rate of expansion is plotted against temperature, provide a ready means of distinguishing between the melting properties of various fats and fat blends. Characteristic curves are given of single fats, hydrogenated fats and blended fats and they are discussed in relation to their predominant glycerides.

Determination of antioxidants in edible fats, Anglin, A., Mahon, J. H. and Chapman, R. A., *J. agric. Fd. Chem.*, 1956, 4(12), 1018.—Methods are presented for determining the antioxidants, butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA) propyl gallate (PG), non-dihydroguaiaretic acid (NDGA), and all combinations except those containing both propyl gallate and non-dihydroguaiaretic acid. Butylated hydroxyanisole and butylated hydroxytoluene are separated from the fat and the other antioxidants by distillation with superheated steam. The distillate is analyzed for the sum of butylated hydroxyanisole and butylated hydroxytoluene with ferric chloride-2,2-bipyridine and for butylated hydroxyanisole with 2,6-dichloroquinone-chloroimide, thereby permitting butylated hydroxytoluene to be

determined by difference. Nondihydroguaiaretic acid and propyl gallate are extracted from a carbon tetrachloride solution of the fat using 50 per cent ethyl alcohol and are determined with ferrous sulfate buffered to an appropriate pH. Butylated hydroxyanisole and butylated hydroxytoluene, although partially extracted with 50 per cent ethyl alcohol, do not react with ferrous sulfate.

Vitamin A and carotene stability in feeds containing antioxidant treated animal fats, by Siedler, A. J., *et al.*, *J. agric. Fd. Chem.*, 1956, 4 (12), 1023.—Experimental storage tests were conducted on the effect of antioxidant-treated animal fat in increasing the stability of vitamin A, carotene, and the fat in commercial poultry feeds. Antioxidants tested were 2- (and 3-) *tert*-butyl-4-hydroxyanisole (BHA); 6-ethoxy-2, 2, 4-trimethyl-1, 2-dihydroquinoline (Santoquin); BHA plus 2, 5-di-*tert*-amylhydroquinone (DAH); 2, 6-di-*tert*-butyl-*p*-cresol (BHT); BHA plus BHT; and *N, N'*-diphenyl-*p*-phenylenediamine (DPPD). All the antioxidant treatments were effective in increasing the vitamin A, carotene, and fat stability over that observed when non-stabilized fat or no fat was added. Santoquin was shown to be the most effective of the antioxidants tested at the 0.02 per cent level, followed closely by DPPD, BHT, and BHA plus BHT.

Preliminary report on the nutritional significance of bound gossypol in cottonseed meal, by Baliga, B. P. and Lyman, C. M., *J. Amer. oil Chem. Soc.*, 1957, 34 (1), 21.—A procedure is described by which bound or inactivated gossypol can be removed from cottonseed meal without the application of heat which might damage the protein. The removal of bound gossypol increased the nutritional value of the protein as determined by chick feeding tests, rat protein-repletion tests, and lysine availability tests. A procedure is described for the preparation of a gossypol-cottonseed protein complex without heating the materials. As

a result of the combination of the protein with gossypol, marked reduction in nutritional value occurred. The nitrogen solubility of the complex was only about half that of the original protein. The results are in accord with the concept that the inactivation of gossypol during the processing of cottonseed meal is accomplished through the formation of an insoluble, inert gossypol-protein complex which results not only in rendering the gossypol harmless but also in the loss of part of the nutritional value of the protein.

Design and operation of a commercial soyabean oil refining plant, using acetic anhydride as a degumming agent, by Noel Myers, *J. Amer. oil Chem. Soc.* **34**, (93), 1957.—The usual refining process for soyabean oil consists in first degumming with water, followed by caustic refining, bleaching and deodorization. In this process, the water removes only 90 per cent of the break material, hence the need for alkali refining. A process was worked out, using acetic anhydride whereby all the break material separated after the addition of water. As the free fatty acids can be removed during the deodorization step, this eliminates the need for alkali refining altogether. A plant to work 10 tank cars/day was set up and data collected over a prolonged period has been presented. This process has shown a clear saving of 0.89 lb. of oil for every cwt. of deodorized oil manufactured. In addition 0.32 lb. of extra lecithin has been obtained. In considering, the advantages and disadvantages of the process, it has been shown that the maximum benefit would go to the manufacturer, who sells both refined oil and lecithin.

S.S.K.

The antioxidant properties of garden cress and wild mustard, by Lotfy, M., Aref, H. and Hussein, A. A., *J. Amer. oil Chem. Soc.*, 1957, **34**, 96.—The garden cress oil and wild mustard oil, which are natural contaminants of linseed available in Egypt, have been generally believed to contri-

bute to the stability of the linseed oil. This paper attempts to evaluate the antioxidant action of these oils in relation to the unsaponifiable matter present in these oils. Tocopherol was identified as the only active antioxidant in these oils. A protective value of 2-4 for linseed oil was observed when either of the above two oils is admixed at concentrations between 10-25 per cent. No synergistic effect between these oils was observed.

S.S.K.

Procedure and apparatus for plasticizing fats in the laboratory, by Steffen, A. H. and Vander Wal, R. J., *J. Amer. oil Chem. Soc.*, 1957, **34**, 159.—The pound cake volume baking tests have been used for testing the quality of shortenings for baking purposes. This shortening has to be plasticized and tempered in order to get consistent and reproducible results. This work describes a simple apparatus which simulates the action of the commercial equipment but requires only 8 oz. of fat. The apparatus consists of a planetary type mixer, Hobart Kitchen-aid Mixer Model K-4-B, cooled in a water bath. The sample, heated to 60°C is cooled with stirring to 40°C, transferred to the mixer, and beaten up for 10 minutes, at speed 4 and with the water bath at 10°C. The procedure has been claimed to be fast, simple and a useful tool in evaluating experimental shortenings.

S.S.K.

TEA

The phenolic substances of manufactured tea I.—Fractionation and paper chromatography of water-soluble substances, by Roberts, E. A. H., Cartwright, R. A. and (Miss) Oldschool, M., *J. Sci. Fd. Agric.*, 1957, **8** (2), 72.—Methods are described for the fractionation of the complex mixture of phenolic substances and their oxidation products occurring in manufactured tea. Products of the oxidation detected include two fractions, S I and S II, responsible for the greater part of the colour intensity of a tea infusion, and nine

unidentified substances, A, B, C, D, P, Q, X, Y and Z. S I and S II have been obtained almost free from other contaminants. They have acidic properties, and mean molecular weights of the order 600. They are probably mixtures of dimers, each dimer consisting of two oxidized flavanol units. X and Y have no acidic properties and are also distinguished from S I and S II by several characteristic colour reactions. P may be an anthocyanidin.

GENERAL

The destruction of vitamin E in flour by chlorine dioxide, by Moore, T., *et al.*, *J. Sci. Fd. Agric.*, 1957, **8** (2), 97.—Chemical estimations of the tocopherols present in wheaten flours treated with chlorine dioxide, or untreated, have been made by a method which allows the separation of the different forms of the vitamin. The chlorine dioxide caused almost complete destruction of each of the tocopherols. Biological tests demonstrated that untreated flour, when included as the main component of the diet of rats, contains enough tocopherol to satisfy their requirements. Rats developed various signs of avitaminosis E, however, when they were given a similar diet containing flour which had been treated with chlorine dioxide. Enough tocopherol survived during the baking of bread from untreated flour to suffice the requirements of rats. Improvement with potassium bromate or ascorbic acid did not appear to decrease the tocopherol content of bread, but some destruction was caused by the aeration process of bread making.

Essential amino acid content of farm feeds, by Lyman, C. M., Kuiken, K.A. and Hale, F., *J. agric. Fd. Chem.*, 1956, **4** (12), 1008.—One hundred and fifteen different feed ingredients and related products were analyzed for each of the 10 essential amino acids. The classes of materials include the following: algae (used as feed ingredients in England), animal by-products, fermentation feeds,

fish by-products, grains, grain by-products from milling and processing, oil-seed residues, peas, and beans. The determination were made by the use of microbiological assay procedures which have been studied and improved by the authors over a period of years. Amino acid content of feed ingredients has become an important factor in modern concepts and practice in feed formulation for poultry and swine.

A continuous dehydrator, by Howard Fox, *Food*, 1957, **26** (305), 56.—The A reports in this paper the evolution of a new and latest type of drying equipment called the belt-trough continuous drier. The description and working of the drier are given. Hot air obtained by direct combustion of gas is passed into the drier to serve as the drying medium. The belt-trough drier is a continuous one and is much more efficient than the conventional cabinet and tunnel driers. There is also no damage done as the material is mixed continuously. In the belt-trough drier, carrots, celery and pimentos cut into $\frac{3}{8}$ in. slices are dried to 56 per cent weight reduction at 300°F dry-bulb and 110°F wet-bulb air inlet temperatures in about 20 minutes. The capacity of the drier under the above conditions is about 275 lb. of fresh material per hour.

K.L.R.

The electrophoretic isolation of dye-stuffs in foods, by Williams, J. F. *Analyst*, 1957, **82**, 211.—The isolation of dye from foods is a very difficult problem because of the absorption of the dye on protein and the subsequent loss of the dye when removing the protein from extracts. In this note, the author describes an electrophoretic method based on the work carried out by Anderson and co-workers which has been successfully applied to biscuits, jam and cream confectionery. The material is extracted with *n*-butanol saturated with 2 N HCl. The extract is filtered in a Buchner and concentrated under vacuum at a temperature not exceeding 45°C. The resulting residue is spread on a 24-inch × 5-inch strip of Whatman 3 MM paper in a zone fashion. Electrophoresis is then carried out at 600 V with a current of 10 mA and using a buffer solution of pH 12 as the electrolyte. Discrete zones of the component dyes are obtained after about 4 to 6 hours of electrophoresis. The electropherogram is dried, the colour zones are cut out, eluted with distilled water and finally their absorption spectra are determined from which the component dyes can be identified. In the case of foods containing large quantities of dye-stuff, the component dyes present in the eluates from the electropherogram can be identified

by paper chromatographic procedure.

K.L.R.

Programme of food sterilization by gamma rays, by Andrew Moldevan, *Canad. Fd. Industr.*, 1957, **28** (2), 17.—A study on the utilization of waste radioactive products of atomic energy reactor in the production of gamma rays for the sterilization of foods is discussed. The waste radiation is concentrated into various radioactive isotopes in the form of rods and plates which are sheathed in metallic containers. The rods are arranged in the form of cylinders and the plates in the form of pentagonal tubes and the tins of food are circulated slowly and uniformly throughout the radio-active zone until each particle of food has received a predetermined dose of gamma rays in a given time. Few types of 'gamma-izers' are cited. The physical, chemical and biological factors of foods in determining the germicidal, bactericidal and fungicidal doses, the cumulative effect of gamma rays in the human body through consumption of irradiated foods, the susceptibility of vitamins and other nutrients, and the development of undesirable organoleptic changes are yet to be established. Lethal doses for humans, insects, bacteria, viruses, etc., are given.

G.V.K.

LIST OF ABSTRACTORS

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TETRAZOLIUM REDUCTION TEST IN RELATION TO SPECIES OF FISH, pH OF THE MEDIA AND INCUBATION PERIOD

Kuhn and Jerchel¹ showed that colourless tetrazolium salts when reduced in neutral solution by yeast, garden cress and bacteria are stained red by the formazan so produced. Later Schonberg², Mustakallio³ and Lakshminarayana and Iya⁴ applied the tetrazolium reduction test for assessing the quality of milk.

Since the constituents of the fish muscle exert a poisoning action on many redox indicators⁵, attempts were made to use a highly electropositive dye 2-3-5-triphenyl tetrazolium chloride (TPTZ) for assessing the quality of iced fish, the decomposition of which is ascribed, almost exclusively, to bacterial activity. While this work was in progress, three papers have appeared on the use of tetrazolium salts for determining the quality of iced fish^{6, 7} and the cured fish products.⁸

The investigations reported herein point out certain interesting findings associated with the reduction of TPTZ in relation to species of fish, the pH of the reaction media, and the various incubation periods.

A uniform representative sample of 2.5 ml. of press juice from muscle was aseptically added to sterile test tubes containing 2.5 ml. of McIlvaine phosphate buffer of specified pH, 10 ml.

distilled water (presence of a suitable quantity of water stimulates the reduction of TPTZ to formazan) and 2.5 mg. of 2-3-5-triphenyl tetrazolium chloride (Hopkins and William Co. London). After shaking, the tubes were immersed in a thermostat at $38^{\circ}\text{C.} \pm 0.1$ protected from direct sun-light. After suitable intervals, the formazan formed was shaken with n-butanol and centrifuged. The transmission of butanol eluate (diluted if necessary) containing the red formazan was read in a Lumetron photo-electric colorimeter using a 490 (m μ) filter. The quantity of the dye reduced was read off from a calibration curve obtained by plotting percentage transmission against known concentrations of formazan prepared according to Fairbridge *et al.*⁹

The tetrazolium method was applied to freshly caught river fish, market samples, and to frozen samples of fish. Kun and Abood¹⁰ found that the reduction of TPTZ takes place in the presence of succinic dehydrogenase at pH 7.4, but stated that in the absence of the succinate, tissue homogenates do not reduce tetrazolium salt except under strongly alkaline conditions. In these investigations, interesting results were obtained while studying the reduction of TPTZ in relation to species of fish and the pH of the media ranging from 6.0-7.5. pH below 6.0 was not used because Jambor¹¹ has shown by polarographic study that in media of pH lower than 6.0, the reduction of tetrazolium yields chiefly a colourless product. It was observed that staler the fish, the quicker was the formation and greater was the amount of formazan produced. In certain species of fish, the colour of formazan is first seen at the bottom of the tubes, because of the sedimentation of the bacterial clumps.

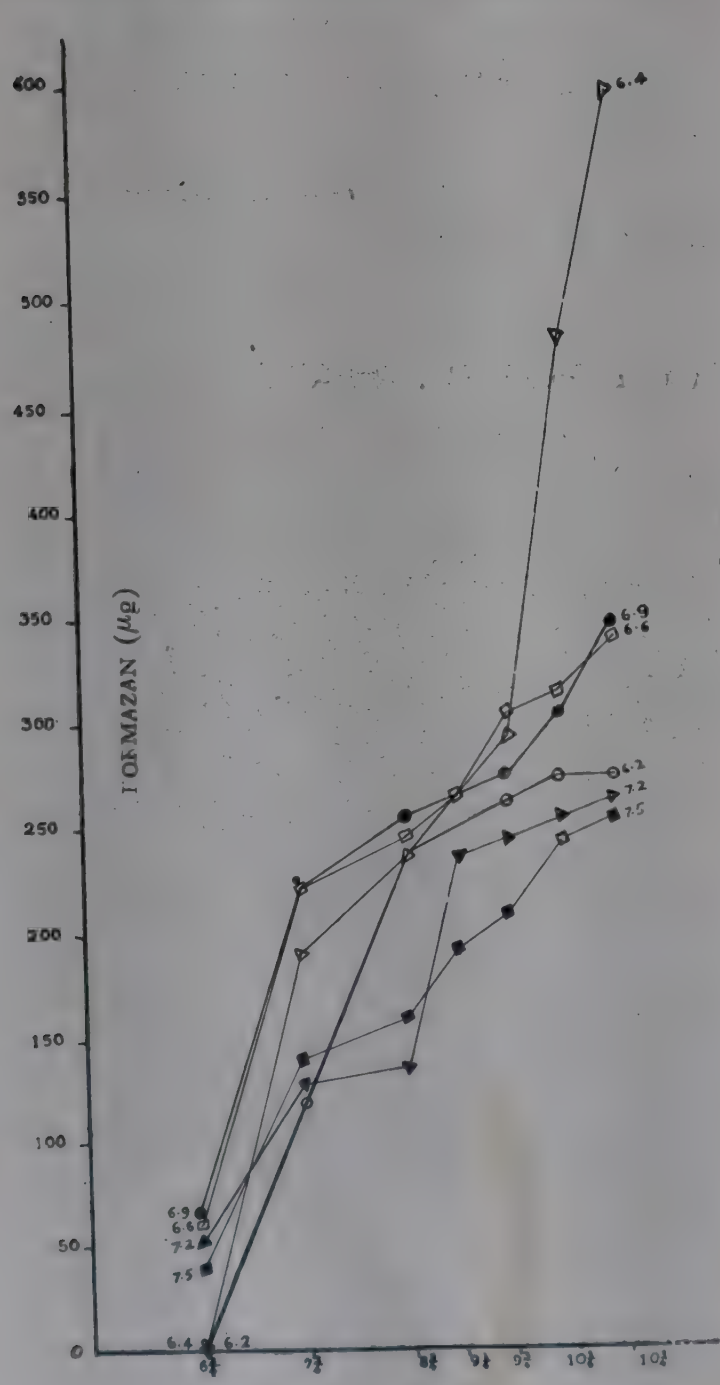
The results of some of the species of fish studied in this work are briefly described in Table I and they show the significant influence of species of fish, the pH of the reaction media and time of incubation on the reduction of the TPTZ. A typical study on cat fish (*Wallago Attu*) and 'Gende' (*Barbus Carnaticus*) is graphically shown in figs. 1 and 2 respectively. A little shift in pH

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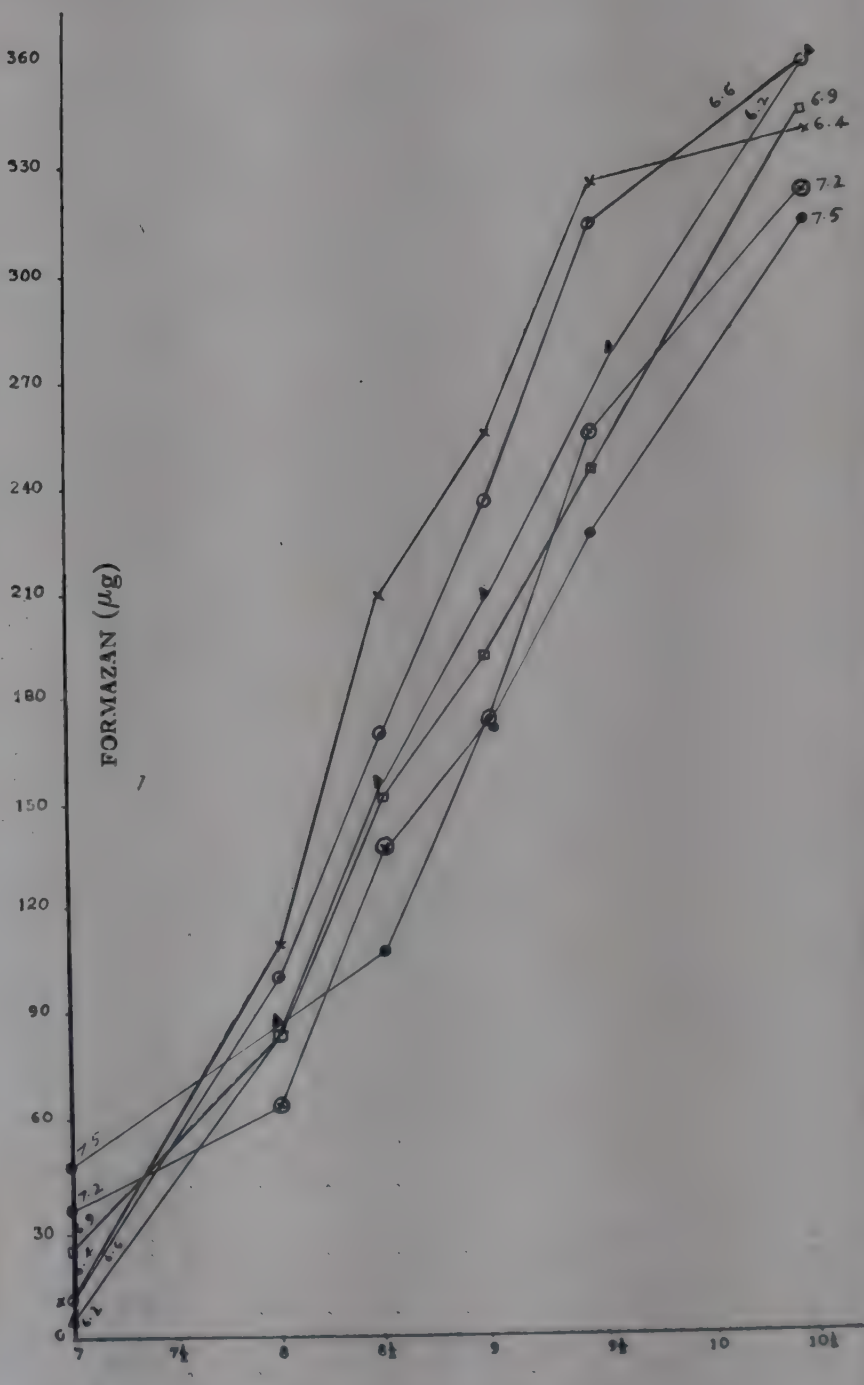
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TABLE I. Tetrazolium reduction in relation to species of fish, pH of media and incubation period

| Species | Nature of the sample | Time of incubation | Buffered pH of the media | | | | | |
|---|----------------------|--------------------|--------------------------|-----|-----|-----|-----|-----|
| | | | 6.2 | 6.4 | 6.6 | 6.9 | 7.2 | 7.5 |
| | | | Formazan (μg) | | | | | |
| "Gende" (<i>Barbus Carnaticas</i>) | Freshly caught | 7 hr. | 4 | 10 | 10 | 25 | 36 | 48 |
| | | 8 " | 84 | 111 | 101 | 84 | 66 | 86 |
| Prawns (<i>Penaecus Indicus</i>) | Frozen | 5 " | 0 | 8 | 46 | 59 | 55 | 29 |
| | | 7 " | 114 | 135 | 153 | 153 | 99 | 77 |
| Cat fish (<i>Wallago Attu</i>) | Freshly caught | 6 " 45 min. | 0 | 0 | 62 | 66 | 53 | 40 |
| | | 7 " 45 min. | 119 | 191 | 222 | 222 | 127 | 142 |
| "Kooralu" (<i>Barbus dubius</i>) | Local market sample | 5 " | ... | 86 | 68 | 62 | 47 | 55 |
| | | 8 " | ... | 183 | 177 | 194 | 183 | 147 |



Time in hours
Fig. 1



Time in hours
Fig. 2

results in stimulating or inhibiting the TPTZ reduction to formazan. The divergent results may be ascribed to the wide range of bacterial species with diverse biochemical activities encountered in fish spoilage.

The spoilage of fish is judged from the time taken for the development of distinct pink colour due to the reduction of TPTZ to formazan. This study brings out the importance of species of fish to be taken into consideration while applying the time factor of the tetrazolium reduction test to assess the quality of fish. The maximum reduction of TPTZ to formazan is not specific to a particular pH; it changes with the species of fish for a given incubation period.

The details of this work will be communicated later.

Our thanks are due to Drs V. Subrahmanyam

and D. S. Bhatia for their keen interest and helpful suggestions.

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SUPPLEMENTARY VALUE OF INDIAN MULTIPURPOSE FOOD TO POOR VEGETARIAN DIETS BASED ON ITALIAN MILLET (*SETARIA ITALICA*) AND LITTLE MILLET (*PANICUM MILLIARE*)

Italian millet and little millet are two important millets used as staple food in the diets by the poorer class of people in certain regions of Madras, Andhra and Mysore States. The nutritive value of poor vegetarian diets based on Italian millet and little millet was studied by Kadkol and co-workers^{1,2}. They reported that the diets based on the two millets promoted a low rate of growth in rats and were inferior in their growth-promoting value to diets based on wheat. Chitre and Ganapathy³ reported that the proteins of Italian millet are deficient in certain essential amino acids especially lysine and tryptophan and promoted very little growth in albino rats at 10 per cent level.

Earlier investigations from this laboratory⁴ have shown that Indian multipurpose food (a low cost protein supplement) when incorporated at 12.5 per cent level, has a marked supplementary value to poor Indian diets based on rice, wheat, *ragi* (*Eleusine Coracana*) and *jowar* (*Sorghum Vulgare*). In view of the low growth-promoting value of the poor Italian millet and little millet diets, it was considered of interest to investigate the supplementary value of Indian multipurpose

food at 12.5 per cent level to poor vegetarian diets based on Italian millet and little millet.

Italian millet and little millet used in the present investigation were cultivated in the lands attached to the Institute. The grains were thoroughly cleaned to remove grit and other foreign matter and then husked. The husked millets were then powdered to about 50-60 mesh in a mill and used for the preparation of experimental diets.

The supplementary value of the Indian multipurpose food as compared with the American multipurpose food at 12.5 per cent level to poor vegetarian diets based on Italian millet and little millet were studied by the rat growth method. The composition of the poor vegetarian diets was the same as that described by Subrahmanyam *et al*⁵. Groups of freshly weaned albino rats (12 in each group and distributed equally according to sex, litter and body weight) were fed *ad lib* on poor vegetarian diets based on Italian millet and little millet and the same diets in which 12.5 per cent of the millet was replaced by Indian multipurpose food or American multipurpose food. The methods adopted for the preparation

of experimental diets and the feeding of the experimental animals were the same as those described by Subrahmanyam *et al.*⁶ The data regarding the average weekly increase in weight together with the statistical analysis are given in Tables I and II.

TABLE I. *Supplementary value of Indian and American MPF to poor Italian millet diet at 12.5% level*
(6 males and 6 females per group arranged in a randomised block design)

| Diet | Average initial weight (g) | Average gain in weight per week (g) |
|--|----------------------------|-------------------------------------|
| A. Poor Italian millet diet ... | 50.0 | 4.83 |
| B. Poor Italian millet diet + Indian MPF ... | 50.4 | 13.51 |
| C. Poor Italian millet diet + American MPF ... | 50.2 | 14.53 |

Results of test of significance:

A~B Significant at 0.1% level.
A~C Significant at 0.1% level.
B~C Not significant.

TABLE II. *Supplementary value of Indian and American MPF to poor little millet diet at 12.5% level*
(6 males and 6 females per group arranged in a randomised block design)

| Diet | Average initial weight (g) | Average gain in weight per week (g) |
|---|----------------------------|-------------------------------------|
| A. Poor little millet diet ... | 49.8 | 3.91 |
| B. Poor little millet diet + Indian MPF ... | 49.8 | 12.89 |
| C. Poor little millet diet + American MPF ... | 49.9 | 14.56 |

Results of test of significance:

A~B Significant at 0.1% level.
A~C Significant at 0.1% level.
B~C Significant at 1% level.

The results on statistical analysis showed that both Indian and American multipurpose foods when incorporated at 12.5 per cent level had a marked supplementary value to poor vegetarian diets based on Italian millet and little millet. There was no significant difference between the Indian and the American multipurpose foods with respect to their supplementary value to the diet based on Italian millet. American multipurpose food, however, was found to be slightly superior to Indian multipurpose food in its supplementary value to the diet based on little millet.

Our thanks are due to Mr A. N. Sankaran for the statistical analysis of the results.

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INDIAN FOOD LAWS (published in August 1954) pp. v. + 220.

This volume summarizes all important details regarding the history, operation and enforcement of the food laws existing in different States in India, definitions, descriptions and chemical standards for articles of food including permissible additives, (colours, flavours and preservatives) and labelling of foodstuffs. The large number of tables on the comparative chemical standards prescribed for different food commodities in various parts of the country make the book useful for reference and guidance for the public analysts and the legal profession.

Price: Indian = Rs. 4-8-0 (postage extra); Foreign = 10 shillings.

THE ROLE OF TRACER ATOMS IN THE STUDY OF PLANT LIFE *

The brilliant successes of nuclear physics have exerted tremendous influence on the development of many branches of science and engineering, even of such which at first glance seem in no way connected with problems of atomic fission.

In our age machines generating electric current capable of performing all kinds of useful work are set going by atomic energy. With the help of radioactive elements and ionizing radiation many industrial processes are controlled, the geological age of rocks is assessed, the chemical structure of substances is established, processes that take place in the human body and in animal and plant organisms are studied, the nature of organisms is altered and even the historical dates connected with the ancient culture and the development of human society are determined.

But this is only the beginning of a new era—the age of the peaceful uses of atomic power. At present it is as yet difficult to foresee all that can be accomplished with the help of radioactive elements.

This fully refers to biology, which by no means has exhausted all the possibilities opened by modern nuclear physics. Nevertheless, within a short period of time the utilization of radioactive elements has been so far advanced that the outlines of fuller and more precise conceptions of plants' life are becoming clear.

The application of the tracer atom method has enabled us easily to differentiate substances containing the radioactive or nonradioactive isotope in any biological environment or even in a whole organism and to draw conclusions about the normal courses of transformations. If their radioactivity is not high tracer atoms participate in the general metabolism together with the nonradioactive compounds. In order to illustrate this by concrete examples we shall try to depict plant nutrition in the form we see it now after several years of application of the tracer method.

It was known long ago that roots take up from the soil only water and mineral salts and send them up to the above-ground organs of the plants which utilize these nutritive substances. The functions of synthesis were on the whole attributed to the

leaves. Roots were regarded chiefly as intermediaries between the soil and the leaves, as organs that fix the plant in the soil and play a subsidiary role. In some cases they served as a place where organic substances coming in from the leaves may accumulate. The capacity of the roots themselves to form many complex compounds was usually taken little into consideration.

True, already at the beginning of the twentieth century certain scientists (Shultze, Pryanishnikov) demonstrated that roots are not only ~~transmitters~~ transmitters of inorganic substances to the leaves but that they themselves can accomplish the initial transformations of these substances into organic compounds. However, even after this the role of the roots as of an organ actively participating in the general metabolism of the plant continued to be obscure. Leaves were considered, as before, the organs in which not only the initial but also the secondary, more complex organic substances are formed. Thus, the function of assimilation of substances in plants seemed to be concentrated only in the leaves.

Within recent years as a result of the application of the tracer method new considerable successes have been gained in this branch of knowledge.

In 1940, the Soviet scientist V. Kuprevich found that carbon dioxide dissolved in water can penetrate through the cut stems of plants to their leaves and be transformed into starch there. Later we found that roots not only consume carbon dioxide from the soil but send it to the leaves, where in the presence of light the soil carbon dioxide can be utilized for the formation of sugar and other products together with the carbon dioxide taken up from the air. The entire process proceeds so rapidly that already 5-10 minutes after the contact of the roots with the carbon dioxide solution labelled with radioactive carbon the tracer atoms are found in all parts of the plant, especially in the leaves.

With the help of radioactive carbon the internal mechanism of the phenomenon has been also studied quite in detail. It is well known that sugar, formed in the leaves from the carbon dioxide taken up from the air, moves down along the plant until it reaches the roots. The rate of this

* By Academician A.L. Kursanov and received through the courtesy of Information Department of the U.S.S.R. Embassy in India, New Delhi.

downward movement can be now easily and precisely measured with the help of substances labelled with radioactive elements. It attains 40 and even 100 centimeters an hour. As a result the products of the majority of farm plants in the leaves in the process of photosynthesis reach the roots in 30-40 minutes.

In the young roots which are capable of actively uptaking nutritive substances from the soil sugar is decomposed, as a result of which pyruvic acid is formed. This acid is capable of taking up soil carbon dioxide and being converted into oxalic-acetic and malic acids. These acids are precisely the first stable compounds which carry in one of their groups carbon dioxide taken up from the soil. As a result of the mutual transformation of organic acids the soil carbon dioxide may enter into the composition of other acids.

However, it should be kept in mind that such an uptake of carbon dioxide in organic substances cannot as yet be regarded as the nutrition of plants because the free energy of these compounds remains practically the same. However, with the help of radioactive isotopes it was established that organic acids do not remain in the roots but rise to the leaves. Together with them carbon dioxide also very rapidly reaches the green tissues. Here it can once again be released and in the process of photosynthesis form carbohydrates, proteins and other highly caloric products. The possibility of utilizing carbon dioxide which is released from other organic acids has been recently proved by the French researcher Mauise and the Soviet scientist V. Soldatenkov.

A part of the sugar formed in this way in the leaves is once again sent down to the roots. There it is transformed into pyruvic acid and takes up new portions of carbon dioxide which it brings to the leaves. This is a peculiar fundamental process in which the work of the roots and the leaves is inseparable. Thus, with the help of labelled carbon a new means of the inclusion of carbon dioxide in plant metabolism has been disclosed.

By supplying roots with the necessary amount of carbon dioxide a favourable influence may be exerted on crop yields. Experiments conducted within recent years have shown that the manuring

of the soil with ammonium carbonate (instead of ammonium sulfate) or other means of enriching it with carbon dioxide increases yields of sugar beet, spring wheat, corn, and cotton by 10-15 per cent. Elucidation of the capacity of roots to assimilate carbon dioxide is important because it discloses more fully the role of organic manures and soil micro-organisms in meeting the requirements of roots in carbon dioxide.

By observing with the help of labelled carbon the movement of organic acids from the roots to the leaves we become convinced that a certain amount of soil carbon dioxide bound up with organic acids is broken off and utilized by the green cells of the stem usually grouped along the vascular bundles of the plants. As a result in the compact bast tissues, inaccessible to air from without, a large amount of oxygen appears necessary for the active respiration of these tissues. In order to show how great is the significance of oxygen respiration of the conducting cells for the movement of organic substances in plants the results of our experiments conducted with radioactive carbon may be cited. The data obtained from these experiments have shown that inhibition of oxygen respiration in the conducting tissues by carbon monoxide stopped the movement of sugar and other organic substances. In this way the role of chlorophyll-bearing cells which always accompany the conducting tissues was disclosed.

The uptake of carbon dioxide from the soil is directly connected with such a function as the nitrogen and phosphorus nutrition of the plants. This is evidently the most important factor in the process of assimilation of soil carbon dioxide by the plant. It has been recently found that many aminoacids from which proteins are formed are synthesized in the roots. Besides that, it has been established that plant roots form alantoin, cytulline and certain other more complex nitrogenous compounds. Therefore, besides the function of absorption, the root system fulfils another important role connected with the protein metabolism of the whole plant.

At first it seemed as though this aspect of the roots' activity was an independent function not connected with their absorbing capacity. However, with the help of tracer atoms it was disclosed that this precisely is the direct mechanism of

the assimilation of ammonium fertilizers from the soil by the roots.

The application of the tracer method in the field of biology gives ground to state that today the old conception that roots play only the modest role of mere transmitters of mineral substances and water to above-ground organs must be rejected. In the light of new scientific data roots play a leading role in the complex transformations of substances which take place in plants. If a leaf is placed without severing it from the plant for a few minutes in a glass cham-

ber containing radioactive carbon dioxide and illuminated, radioactive sugars and other products of photosynthesis are immediately formed in the leaf tissues. With the help of special apparatuses one can follow the direction and rate of movement of the assimilated products.

Today many difficult problems of agrotechnics are being solved with the help of radioactive elements and more effective possibilities of applying fertilizers are being opened, which helps boost farm crop yields.

DISPOSAL OF CANNERY WASTES*

Water is our greatest natural resource; its conservation has become of increasing importance especially if one considers that modern industry uses enormous quantities of water e.g. Sugar refining, 8,000 gallons per ton; Leather, 10,000 gallons per ton; Milk Powder, 40,000 gallons per ton and Steel, 55,000 gallons per ton.

Fruit and vegetable canneries produce large amounts of waste water; this contains, as a rule, a relatively small amount of screenable solids but is high in water-soluble contaminants. This waste water has, therefore, a high biological oxygen demand and, if stored up, may generate unpleasant odours.

In canneries where lye peeling is used, the waste may also be too toxic for easy bacterial digestion. Beet wastes have the added disadvantage of being highly coloured.

Drawbacks also arise from the fact that canning is a seasonal operation: in the first place, the canning season comes at a time when streams tend to be at their minimum flow; moreover, since the plant will be idle for most of the year, capital cost of the treating equipment must be kept to the absolute minimum or else it will throw a heavy overhead charge on the operation;

finally, for the proper functioning of trickling filters and the activated sludge process, development of a suitable flora is needed—a requirement which may be difficult to meet at the precise period when canning takes place.

Lagooning is quite widely used. Odour can be controlled by addition of sodium nitrate; but complete odour control may sometimes require such large amounts that it becomes too costly.

About 1948, two new disposal methods came into practice: the ridge—and—furrow method and the spray method. In both types, the waste water is applied to the ground in a thin layer. An obvious requirement is that the ground will allow the liquid to seep through it; the land should also be covered by vegetation. Both systems appear to have worked out very well. Occasionally, the increased yield from the irrigation effect produced by these systems covered all waste disposal costs!

(Condensed from Foreword to 'CANNERY WASTES DISPOSAL', a selected, annotated bibliography by F. G. Green, T. I. S. Report No. 50. The report refers to three abstract journals and six books and contains 93 references to the periodical literature. The report is available free of charge on request to the Technical Information Service, National Research Council, Ottawa.)

* Reproduced from NRC Research News, issued by the Public Relations Branch, National Research Council of Canada, Ottawa, Vol. 10, No. 6, June, 1957.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during July-August 1957 are given below :

S (IS) 210 (157)

Enzymes in Dolichos Lab Lab., by M. V. Patwardhan, (July 27, 1957). The speaker presented his work on enzyme systems in *Dolichos lab lab*. Different enzymes like dehydrogenases, phosphatases and transaminase were studied. Aspartic acid—glutamic acid transaminase was studied in detail. This enzyme was purified about twenty-five fold by dowex—2, calcium phosphate gel and alumina C_γ treatment. This preparation was used throughout further studies. Involvement of iron in the enzymatic transamination was suggested, based on the data presented. It was possible to remove most of the activity from the protein by dialysis for 18 hours in cold against aqueous 8-oxyquinoline and could be replaced by addition of 10γ ferrous iron as ferrous sulfate. Quantitative estimation of iron during purification also supported the above studies. The optimum pH of the enzyme was found to be between 7.4—8.7 depending on the buffer used. Maleic acid was found to have inhibitory effect on the transaminase activity.

During the discussion that followed it was pointed out that non-enzymatic transamination was noticed by other workers in presence of cellulose. Extracts of cellulose also were active. It was suggested that action of some metallic impurity in the paper might be involved in the above effect.

S (IS) 211 (158)

Effects of plant hormones on the storage behaviour of potatoes and onions, by P. B. Mathur, (August 3, 1957). Plant hormones have been successfully employed

during recent years to prolong the storage lives of potatoes and onions. To test the efficacy of terpeneol as a growth inhibitor, potatoes that had been cold stored at 35-38°F and R.H. 85-90 per cent for 8½ months and were free from sprouting were employed. Strips of filter paper were soaked in 1.5 c.c. of the hormone and distributed in gunny bags. Treated and untreated potatoes were stored at 52-55°F, 65-68°F, 71-75°F and room temperature (76-86°F). The treatment resulted in reducing the physiological losses in weight and inhibiting the sprouting in potatoes during storage. These effects were most pronounced at 52-55°F. In another experiment, the effect of a fungicidal wax coating alone and in combination with methyl-*α*-naphthalene acetate on the storage behaviour of potatoes was investigated. At the end of 42 days of storage at room temperature (75-77°F; R.H. 47-65 per cent), the percentages of sprouts produced by weight on the basis of sprouted potatoes were as follows: control, 0.62 per cent; wax emulsion, 0.31 per cent and wax emulsion + methyl-*α*-naphthalene acetate, 0.04 per cent. In the third experiment relating to potatoes, the efficacies of maleic hydrazide (as a post-harvest treatment) and isoamyl alcohol were compared with special reference to conditions prevailing during the transportation by trucks of potatoes packaged in gunny bags after a period of storage. Maleic hydrazide was found to be more efficacious than isoamyl alcohol.

In another experiment onion bulbs, the tops of which had been sprayed before harvest with 200, 400 and 600 p.p.m. of maleic

hydrazide solution together with a control were stored at two temperature ranges, viz: 59-87°F (R.H. 45-78 per cent) and 32-35°F (R.H. 80-90 per cent). A dosage of 600 p.p.m. of maleic hydrazide equivalent to 6 mg. of the hormone per plant resulted in complete inhibition of rooting and a very substantial inhibition of sprouting in onion bulbs stored at 32-35°F (R.H. 80-90 per cent). Preharvest foliage sprays of maleic hydrazide also resulted in reducing the wastage due to fungous diseases in onion bulbs stored at both the temperature ranges investigated.

The talk was then followed by an interesting discussion in which various points were raised, e.g. economics of hormone spray, its legal permissibility, number of replications used, quantitative amount of translocation of hormones in onions, its anti-microbial effects, possibilities of using hormones in connection with cereal crops, possibilities of using other materials which can suppress the metabolism of carbohydrates and reduce the respiration rates and reference was made to the chances of utilising the hormone from the aerial roots of Banyan tree. The speaker then explaining various points raised informed the house that the cost involved in the spray of hormones is negligible and some of these hormones are in use in various foreign countries. However, the hormone trials on animals will be carried out later on.

S (IS) 212 (159)

Current trend in food technological researches in U.S.A., by N. L. Lahiry, (August 17 and 26, 1957). The speaker acquainted

the house with some of the latest developments in the field of Food Science and Technology at various research centres in U.S.A. visited by him recently. He presented in detail the processes of dehydration of mashed potatoes, and the preparation of fruit juice powders, developed at the Eastern Utilization Research and Development Division, Philadelphia where the Engineering and Development Division is engaged in the studies of process development, design, construction and operation of pilot plant scale equipments, product and process cost analysis. The most important developments were the use of Chain Belt Vacuum Dehydrator for manufacture of instant coffee at Lansdale, a new electronic apparatus to study the internal infection or breakdown inside the fruits and vegetables, which is otherwise invisible at Beltsville, the effect of picking, maturity and ripening temperature on the quality of canned and frozen peaches, the development of Lee-Kramer Shear Press which accurately measures the force re-

quired to shear the standard volume of material at the Maryland University, where the Horticulture Department is engaged in extensive Extension Service for the benefit of Food Industry as well as to common people. At Fisheries Technology Laboratory, College-Park MD., considerable work has been done on refrigeration of fish, cold storage and design of refrigeration equipment. The speaker described the current researches on the preparation of whole milk powder by spray and puff drying, specification of a number of standards for voluntary uses by the processors, the Mobile Laboratory maintained by National Canners' Association in Washington D.C., the Home Economics Division of the Laboratory from where the knowledge of home canning of fruits and vegetables is disseminated to housewives. The speaker then described in detail various processes of preparation of fish flour for human consumption developed at VioBin Corporation, Monticello, Illinois; freeze dehydration of meat, vacuum dehydration of fruits and vegeta-

bles, new methods of baking of bread, cakes, etc. in small tin cans at Quartermaster Food and Container Institute, Chicago; improvement of food flavour, fat stability and nutritional value with sesame products at the Food Technology Institute, Chicago; development of new containers using synthetic films for packaging of citrus juices at the University of Illinois; possibilities of food sterilization by ionizing radiations and flavour research at M.I.T.; preparation of pre-cooked frozen fish products on commercial scale at Boston; use of oxytetracycline to boost the shelf life of poultry and the use of antibiotics in other foods at Chas. Pfizer Co., New York, and enrichment of rice with vitamins and minerals by Standard Brands Inc., in collaboration with Hoffman-La-Roche in South American countries.

The talk was then concluded by the President who contended that we have in our Institute started work in various directions, suitable to our Indian conditions and much more progress is awaited in coming years.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Dehydration of bananas

E (F) 12204 (382)

Will you kindly give us the details of the method of dehydrating ripe bananas? (Kerala).

The method of dehydrating bananas as standardised in this Institute is as follows:

The fruit is peeled by hand and used as such or cut into halves transversely and/or longitudinally with stainless steel knives. The

prepared fruit is dipped for 15 minutes in a 1 per cent solution of Na_2CO_3 , followed by rinsing in 0.05 per cent citric acid solution and a wash in water. The fruit thereafter is spread on wooden flat bottom trays and sulphured by exposing for one hour to the fumes of SO_2 obtained by burning sulphur at 8 lb./ton of fruit/1000 c.ft. of the sulphur box. This is followed by drying the fruit at 55-60°C. At the finishing stage, the fruit

should be pliable and soft and not sticky.

Utilization of paddy husk

E (IS) 9592 (383)

We get large quantities of rice husk and burnt husk from our rice mill. We would be grateful to you if you could inform us about the possible uses of these commodities? (Calcutta).

Paddy husk, is of little monetary value. It is generally used as

fuel and filler in the fertiliser industry. It can also be used as packing material, bedding for poultry and for the manufacture of alpha-cellulose. The husk ash is used as a bleaching agent, filler for bricks and concrete, in making polishing and cleansing agents and as a source of sodium silicate. Preliminary experiments are under way in this Institute to prepare insulating material and cushion pads from the paddy husk and the details of the above project can only be communicated on the successful completion of the work.

Preparation of cashew apple candy

E (IS) xxxx (384)

May I request you to furnish the details regarding the method of preparing candy from the cashew apple fruit which is grown in large quantities in these parts? (Malabar Dist.)

The details of the method of preparation of candy from cashew apple are as follows:

Select fresh, fully ripe and sound (free from blemish) fruit of any colour. Wash the fruit thoroughly in running cold water rubbing with hands (covered with rubber gloves), if necessary.

Immerse the washed fruit in 2.0 per cent common salt solution and raise the concentration of salt by 2.0 per cent every day so that in 5 days' time it gets to 10 per cent. When the salt concentration reaches 10 per cent, add also potassium metabisulphite at 1 oz. per 100 lb. and keep the fruit in this solution for a further period of 2-3 days. After this, wash the fruit thoroughly in water, put in a perforated crate made of aluminium or monel metal and blanch in boiling water for 5 minutes followed by steaming in a pressure cooker for 5 minutes at 5 lb. pressure. Cool the steamed fruit by rinsing in water and give thorough pricks all round, to each individual fruit, with sharp bamboo needles.

Prepare sugar syrup of 30° Brix by dissolving 4½ lb. sugar in every gallon of water, add 0.1

per cent citric acid and boil for about 10 minutes. Pour the hot syrup over the fruit placed in an enamelled, aluminium, monel metal or stainless steel vessel, adding enough syrup to completely submerge the fruit. Keep the fruit immersed in the syrup by putting over it a flat cover and a weight. Cover the container with its lid and keep it aside for about 24 hours. Next day, drain out the syrup from the fruit, find its Brix and weigh out the sugar to be added to it to raise the Brix to 35°.

Boil the drained syrup for 5-7 minutes, add the sugar, bring to a boil again and pour it back over the fruit. Repeat the heating and steeping process as above, adding enough sugar every day to raise the concentration of the drained syrup by 5° Brix till it reaches 60°; after this, repeat the process on every alternate day till the final syrup strength is 70° Brix. Leave the fruit in the final syrup, for complete absorption of sugar, for a further period of 5-6 days, determining the Brix of the syrup every day and heating it to boiling, if necessary. Strain the fruit on a coarse sieve and finally dry the finished product to make a candy. Pack the dried cashew apple candy in dry screw-capped glass jars and close the jar air-tight. Store the filled jars in a cool, dry place.

Preparation of guava cheese

E (IS) xxxx (385)

I would be very much obliged if you can send me the particulars for the preparation of guava cheese? (Surat).

Guava cheese can be prepared from guava fruit according to the method given below.

Select sound and fully ripe fruit of the best quality and firm in texture. Wash the fruit thoroughly to remove dirt, soil etc., by scrubbing the fruit with hands if necessary. Trim the bruised and blemished portions, if any and cut the sound portions of the fruit into small pieces with stainless steel cutting knives as the ordinary knives stain it black. Add an equal

quantity of water and boil till the fruit softens well. Strain the pulp through a fine mosquito net cloth to separate the seeds and rough skins. The following recipe has been evolved for the product.

| | | |
|---------------------------|-----|---|
| (i) Pulp | ... | 1 lb. |
| (ii) Sugar | ... | 1½ lb. |
| (iii) Butter | ... | 2 oz. |
| (iv) Citric acid | ... | 1 g. |
| (v) Salt | ... | ½ teaspoon full |
| (vi) Colour (red, edible) | ... | Sufficient to give an attractive deep fruit colour to the product |

Mix the ingredients (i) to (iii) and heat till the mass becomes sufficiently thick. Add the remaining ingredients dissolved in a small quantity of water just before finishing. Smear a china plate with butter and spread the finished product over it to form about ¼" thick layer. Allow the product to cool and set and then cut into pieces of attractive shape. Wrap in butter paper and store in a clean, dry glass container which is finally sealed with wax.

Cold storage of Coorg mandarin oranges

E (S) xxxx (386)

Please let me know the optimum cold storage conditions for Coorg mandarin oranges. What is the cold storage life as compared to the life at room temperature and what would be the post cold-storage life? (Bangalore).

The storage of the Coorg mandarin oranges under various conditions is as follows:

| Storage conditions | Storage life at 10% wastage basis |
|--|-----------------------------------|
| 1. Room temperature (79-87°F; R. H. 55-85%) | ... 16 days |
| 2. Cold storage (42-45°F; R.H. 85-90%) | ... 2 months |
| 3. Post cold-storage life at room temperature (79-87°F; R.H. 55-85%) after 2 months cold storage | ... 4-5 days |

NOTE: 1. If the oranges are cold stored for a period shorter than 2 months, the post cold-storage life would be proportionately longer.

2. With the application of a fungicidal wax emulsion, the cold storage life of Coorg oranges can be increased to about 3 months.

Preparation and preservation of jack nectar

E (IS) xxxx (387)

How can we prepare a squash-like product from jack fruit? Please inform the method of preservation of the same. (Shillong).

The various steps in the preparation of Jack Fruit Nectar (squash) are as follows:

Select ripe fruit having succulent bulbs. Cut the fruit across into two halves and then each half lengthwise into four or eight pieces depending upon the size of the fruit. Remove the pithy and gummy core with a sharp knife to free the bulbs. Smear a little cooking oil on the hands to prevent stickiness and separate the bulbs from the rind and the surrounding carpels. Trim the top and bottom of the bulbs and remove the seed

inside along with its thin covering. Cut each bulb longitudinally into 4 or 8 pieces as desired.

Preparation of fruit pulp and sugar syrup: (a) *fruit pulp*: Soften the cut pieces of the bulbs by heating them slowly in about half their weight of water and stirring with a wooden ladle. Mash the softened pieces into a fine pulp by crushing them thoroughly. Rub the pulp through a fine sieve to remove any large pieces. (b) *Sugar syrup*: Prepare sugar of 60° Brix by dissolving 3 lb. of sugar in 2 lb. of water and heating. Remove the scum, if any, and filter the syrup.

Preparation of Nectar: Blend the various ingredients according to the following recipe.

| | | |
|-------------|-----|---------|
| Pulp | ... | 10 lb. |
| Sugar | ... | 22½ lb. |
| Water | ... | 15 lb. |
| Citric acid | ... | 7½ lb. |

Strain the finished product through a muslin cloth.

Preservative: To preserve the product for use over a long period,

add potassium metabisulphite at the rate of 1 ounce per hundred pounds of the prepared nectar. For the recipe given, half an ounce of the preservative will be sufficient. It should be dissolved in a small quantity of water and then the solution mixed well with the product.

Bottling and storage: Fill the nectar in 12 oz. or 24 oz. dry bottles which have been previously cleaned and sterilized by heating in boiling water for 15-20 minutes. Leave head-space of about 2" in the bottle. Close the bottles airtight with crown corks or with ordinary corks. In the case of ordinary corks, dip the mouth of the corked bottle in molten paraffin wax to give a good seal. Keep the bottles in a cool dry place.

Jack nectar is a palatable beverage with pleasant taste and aroma and keeps well. Before use, dilute it with 4-5 volumes of water. It may be taken as such or after carbonation.

Notes and News

STATISTICAL NOTES

Food production statistics for March, April and May, 1957

| Name of Industry | March 1957 | | April 1957 | | May 1957 | |
|--------------------------------|--------------|-----------------------------|--------------|-----------------------------|--------------|-----------------------------|
| | No. of Units | Production during the month | No. of Units | Production during the month | No. of Units | Production during the month |
| Confectionery ... | 34 | 771 tons | 29 | 676 tons | 24 | 560 tons |
| Biscuits ... | 27 | 1,083 " | 23 | 1,202 " | 17 | 887 " |
| Flour milling ... | 33 | 49,595 " | 30 | 42,036 " | 27 | 51,461 " |
| Oil milling ... | 100 | 57,688 " | 110 | 25,120 " | 90 | 20,250 " |
| Butter (tinned) ... | 5 | 91 " | 5 | 83 " | 4 | 27 " |
| Cashewnuts ... | 13 | 1,534 " | 14 | 1,444 " | 13 | 1,659 " |
| Dal and gram flour ... | 2 | 667 " | 1 | 350 " | 1 | 375 " |
| Aerated water ... | 32 | 43,473 gross bottles | 29 | 61,066 gross bottles | 20 | 46,961 gross bottles |
| Beer ... | 2 | 96,377 gallons | 2 | 106,260 gallons | 2 | 141,212 gallons |
| Country spirit ... | 22 | 461,000 " | 21 | 459,000 " | 19 | 333,000 " |
| Indian made foreign liquor ... | 14 | 72,500 " | 13 | 60,000 " | 11 | 40,000 " |

(Ministry of Commerce and Industry, Government of India)



Shri Chandulal M. Trivedi being explained the work of the Institute

C.F.T.R.I. NEWS

The following distinguished persons visited the Institute during July, August, and September, 1957.

17-7-1957. Dr S. R. Mehra, Director, Central Road Research Institute, Delhi.

20-7-1957. Dr Krishnamurthy, Raman Research Institute, Bangalore.

23-7-1957. Mr G. K. Agarwal, Chief Engineer, U.P. Government; Dr K. L. Rao, Member, Central Water and Power Commission, Delhi; Dr Kulkarni, Soil Physicist, Poona; Mr E. L. Khanna, Executive Engineer, Irrigation Department, Madhya Pradesh; Mr D. P. Jog, Superintending Engineer, P.W.D., Madras; Mr Joglekar, Director of Central Water and Power Station, Poona and Mr Kunwar Sain, Chairman, Central Water and Power Commission, New Delhi.

25-7-1957. Mr Walter Friendberg, Fellow, Institute of Current World Affairs, New York, Mr Ratilal Gandhi, Vice-President and

Members of the Central Oilseeds Committee, Hyderabad.

26-7-1957. Shri P. Venkatasubbiah, Member of the Lok Sabha, Kurnool District, Andhra.

27-7-1957. Mr R. N. Chatur-

vedi, Senior Marketing Officer, Government of India, New Delhi.

1-8-1957. Dr Robjohns, Australian and Asian Association, University of Adelaide.

6-8-1957. Members of the Southern Regional Committee and the Coastal Regional Committee of the I.C.A.R., New Delhi.

20-8-1957. Members of the Scientific Advisory Committee of the C.F.T.R.I.

27-8-1957. Mr K. G. K. Rao, Deputy Comptroller, S. E. Railway, Nagpur.

2-9-1957. Mr Ashok Kumar Sen, Managing Director, East India Pharmaceutical Works Ltd., Calcutta; Dr R. V. Chanda, Dairy Chemist, Calcutta; and Dr Deodikar, Honorary Research Director, Apicultural Laboratories, Poona. Shri Chandulal Trivedi, till recently Governor of Andhra Pradesh and a Member-designate of the Planning Commission.

10-9-1957. Mr I. C. Subbiah, Deputy Commissioner, Coorg.

18-9-1957. Mr N. S. Srikantiah, Deputy Secretary, Ministry of Agriculture, New Delhi.

20-9-1957. Shri Jawaharlal Nehru, Prime Minister of India and Shri T. Mariappa, Minister for Finance, Government of Mysore.



Dr Jivraj Mehta examining the different aspects of Tapioca Macaroni

21-9-1957. Shri Govind Ballabh Pant, Home Minister, Shri Morarji Desai, Minister for Industries and Commerce and Shri S. K. Dey, Minister for Community Development, Government of India. Dr Jivraj Mehta, Minister for Finance, Government of Bombay and Shri S. V. Ramamurthy, Adviser, Planning Commission

24-9-1957. Shri U. N. Dhebar, President, Indian National Congress and Shri S. Channiah, President, Mysore Pradesh Congress Committee.

27-9-1957. Shri Jaya Prakash Narayan.

28-9-1957. Shri Vinoba Bhave, the Bhoodan Leader.

30-9-1957. Shri H. C. Dasappa, Member of the Lok Sabha.

Appointments and Postings

Assistant Directors

Sri Y. K. Raghunatha Rao (Food Engineering Division).

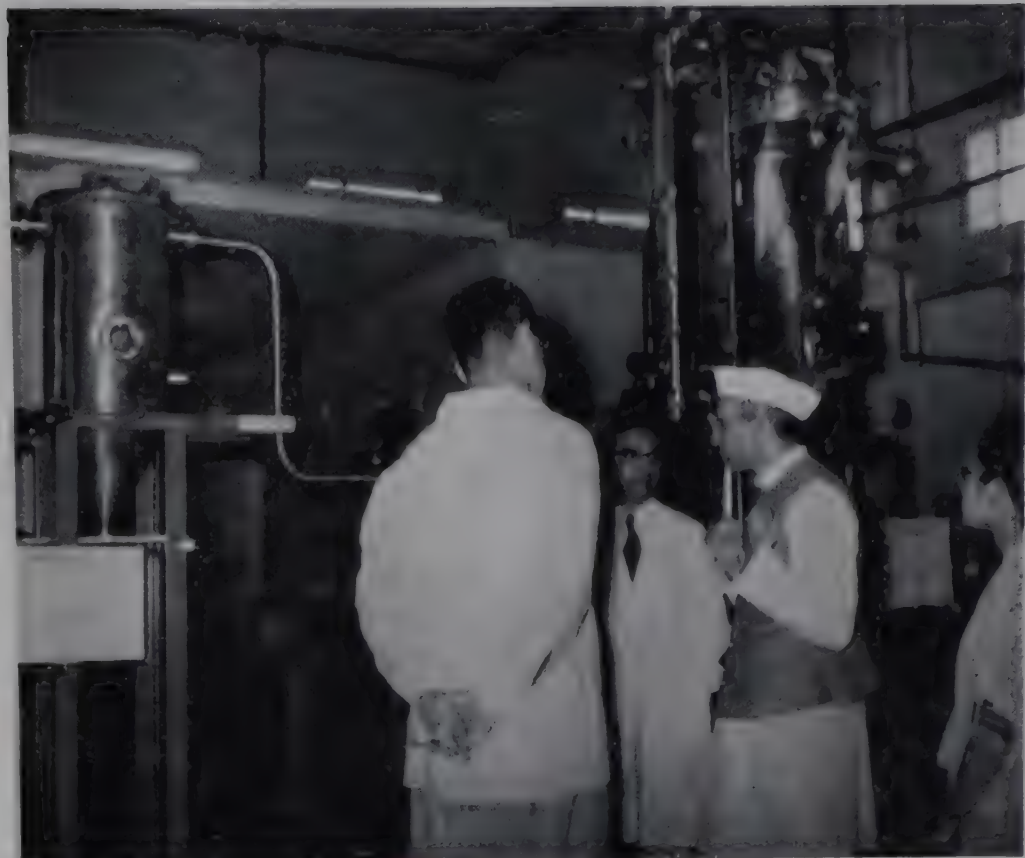
Dr N. L. Lahiry (Process and Development Division).

Senior Scientific Officer

Dr. R. Rajagopalan (Dietetics Division).

Junior Scientific Assistants

Mr N. S. Satyanarayana Rao (F. P. O. Scheme)



Shri U. N. Dhebar showing keen interest in the equipment fabricated at the Institute

Mr P. K. Mital (F. P. O. Scheme)

Mr J. I. D'mello (Pilot Plant Project)

Research Assistants

Shri P. P. Kurien (I.C.M.R. Scheme).

Shri R. Sivaramakrishnan (I.C.M.R. Scheme).

Miss N. Seetha Ganapathy (I.C.M.R. Scheme)

Shri T. K. Ramakrishnan (I.C.O.C. Scheme).

Shri P. K. Tasker (I.C.O.C. Scheme)

Research Fellowships

Shri M. Kantharaj Urs and Shri K. Visweswariah have been awarded the Senior Research Fellowships of the C.S.I.R.

Shri P. V. Subba Rao has been awarded the Junior Research Fellowship of the C.S.I.R.

Nominations

Dr V. Subrahmanyam, Director has been nominated as a member on the 'Vegetable Oil Products Technical Committee'.

Mr S. K. Majumdar has been elected a Fellow of the Royal Entomological Society of London (F.R.E.S., Lond.).

Announcements

Unesco Press Release No. 1680

The UNESCO is organising an International Conference on Radio-isotopes in Scientific Research to be



Shri S. K. Dey being explained the publications and extension services programme of the Institute

held in the new School of Medicine of the University of Paris. It will be presided over by Sir John Cockcroft, British Nobel Prize Winner and Director of the Atomic Energy Research Establishment at Harwell. Work in the field of atomic energy has led to the production of a large number of isotopes in recent years which have created entirely new fields of research. Among present-day uses of radio-isotopes are biology, physiology, agriculture, medicine, oceanography and industrial research. A selection of 200 papers will be presented on various aspects of the use of radio-isotopes in scientific research.

I.S.I. Specification for commercial metric weights

India has decided to go 'metric'. The Government of India have now set 1 April 1958 as the D-Day for the introduction of the metric system. The changeover to the new system on a countrywide basis will need manufacture of the new weights and measures in the metric system on a very large scale. The Indian Standards Institution has just issued a specification for commercial Weights and has reached the final stages of drafting of specification for capacity measures.

The new published Indian Standards covering commercial weights specify details in respect of dimensions, materials and tolerance of the different series of weights prescribed in the standards. All the drawings that a manufacturer may need for fabricating the prescribed series of weights have also been included in the specification.

The standard specified the use of cast iron and forged steel, brass

and bronze and sheet metals for different types of weights.

Cast Iron and Steel types consist of two series:

(i) Weights of 50 kg., 20 kg., 10 kg. and 5 kg. are of hexagonal shape with handle for convenience in handling.

(ii) 2 kg., 1 kg., 500 g., 200 g., 100 g., also of hexagonal shape, and a distinct taper, but without handle. In this series, the consecutive weights are so designed as to nest in one another.

Brass and Bronze types of weights—Two series of cylindrical shape for use in bullion trade, consisting of:

(i) Weights of 20 kg. and 10 kg. with handle and 5 kg. to 1 g. with knob, and

(ii) Flat cylindrical shape for use by goldsmiths from 1 kg. to 1 g.

There is also another series of flat cylindrical shape, but with a distinct downward taper ranging from 1 kg. to 1 g. which is meant for supplementing cast iron and forged mild steel weights.

The sheet metal type consists of two series of weights, one of which is recommended for ordinary use, and the other for bullion use.

In the series for ordinary use the weights of 5 mg. and its decimal multiples such as 50 and 500 mg. are of hexagonal shape; the weights of 2 mg. and its decimal multiple of square shape and those of 1 mg. and its decimal multiples triangular.

Weights for use in the bullion trade are cylindrical in shape.

The special shapes chosen for these weights are entirely different from the shapes of weights now current in the country. This is

deliberate, and is expected to avoid confusion during the change-over.

The basic series of weights adopted in the standard is 5, 2, 1 and, therefore, for making complete sets, one additional weight of relevant decimal multiple of 2 will be necessary in addition to the denominations of different prescribed weights. The suppliers and purchasers of these weights will have to bear this in mind as otherwise the set will be incomplete for use.

The commercial weights specification is the first of a series being issued by the I.S.I.; the other specifications taken up so far cover metric capacity measures, carat weights, commercial metric length measures, metric dispensing measures, metric woven metallic and metric steel measures.

The standard for commercial metric weights (IS: 1056-1957) is available at Rs 2.00 per copy with the Indian Standards Institution, 19, University Road, Delhi-8.

BOOK REVIEW

Medical Digest: Silver Jubilee Number (1933-1957) Vol. 25, No. 6, June, 1957.

This is a comprehensive number of great value to all medical practitioners. It covers the progress made in the various fields of medicine and surgery over the last 25 years. Particular mention must be made about articles on Anaesthesiology, Geriatrics, Industrial Medicine, Occupational Therapy, Planned Parenthood, Plastic Surgery and Hospital and Social Service. Besides these, there are several original articles contributed by eminent medical men from India and abroad.

R. K. BHAGAVAN

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

A convenient method for the estimation of fluorine in waters containing excessive amounts of interfering ions, by Venkateswarlu, P., and Narayana Rao, D., *Indian J. med. Res.*, 1957, **45** (2), 273.—A large volume of the water to be analysed for fluoride is boiled with a small quantity of magnesium oxide. The magnesium oxide with the adsorbed fluoride is separated by centrifugation or filtration and submitted to the Willard-Winter distillation; the distillate is titrated for fluoride. This method is more convenient and rapid than the conventional method which involves evaporation of a large volume of water prior to the distillation to free the fluoride from the interfering ions.

BIOCHEMISTRY AND NUTRITION

Influence of continued feeding of curds and sulphaguanidine on the intestinal synthesis of thiamine, by Baliga, B. R., *et al.* *J. sci. industr. Res.*, 1957, **16C** (7), 152.—The influence of including curds in the basal diet, and sulphaguanidine in the basal diet with or without curds, on intestinal synthesis of thiamine in rats has been investigated. While the inclusion of curds increases the synthesis of thiamine in the intestinal tract of rats and improves the growth of the experimental animals kept on sub-optimal doses of thiamine in the diet, sulphaguanidine inhibits the intestinal synthesis and retards the growth of rats. Sulphaguanidine fed along with curds does not inhibit thiamine synthesis; the growth of rats under these conditions is satisfactory.

K.L.R.

Enzymatic synthesis of ascorbic acid in animal tissues, by Chatterjee, I. B., *et al.*, *Sci. & Cult.*, 1957, **23** (1), 50.—Animal tissues *viz.*: liver tissues of the mouse, rabbit and notably goat convert D-glucuronolactone into ascorbic acid in presence of potassium cyanide ($5 \times 10^{-2}M$), the increase in the ascorbic acid content being 2-3 times that originally present in the tissue. No such conversion takes place without cyanide. This effect is not found in liver tissues of the guinea pig, pigeon and chick. Even other substrates like sodium glucuronate, sodium galacturonate and sodium gluconate used in place of D-glucuronolactone or metallic inhibitors like 2:4-dinitrophenol, sodium azide, phlorizin and chlore-tone do not have any influence on the synthesis. Co-factors like D.P.N., Mg^{++} and CoA are not needed for this synthesis. The synthesis brought about by cyanide is diminished to the extent of 40-50 per cent when 0.0016M ATP is used while no such reduction is observed with ADP, AMP, adenosine or adenine. Some inhibitors like p-chloro-mercuric benzoate and mercuric chloride are found to reduce the synthesis to a great extent. The conversion of D-glucuronolactone to ascorbic acid does not take place in presence of N_2 , thus indicating the apparent need for oxygen for the biosynthesis. The significance of the above results with respect to the biosynthesis of ascorbic acid in animal tissues has been discussed.

K.L.R.

Serum cholesterol and phospholipid contents of normal Indian Service Personnel by Nath, H. P., Gupta, K. K. and

Iyer, P. V. K. *Indian J. med. Res.*, 1957, **45** (2), 217.—The paper describes the results of studies on the serum total, free and ester cholesterol, lipid phosphorus of normal Indian Service Personnel of the age groups 20 to 30, 31 to 40, 41 to 50 and 51 to 60 years. Total serum-cholesterol content of the above age groups is 177 mg. per cent, 195 mg. per cent, 208 mg. per cent and 215 mg. per cent, respectively and this is almost the same as that reported for Europeans and Americans, but is slightly higher than that reported by other workers for Indians. Cholesterol content increases with age, weight and appears to be independent of smoking, alcoholic habits and racial differences between the subjects. Cholesterol content of non-vegetarians has been found to be 16 per cent more than that for the vegetarians. The ratio of total cholesterol to lipid phosphorus is almost the same for all age groups. The lipid phosphorus content is, however, slightly less in the age group 20-30 as compared to the other groups.

Effect of different cereals on blood sugar levels, by Ramanaathan, M. K. and Gopalan, C., *Indian J. med. Res.*, 1957, **45** (2), 255.—The response of the blood sugar levels to the administration of different cereal diets containing identical amounts of carbohydrate was investigated in six normal subjects and in two cases of glycosuria. The rise in blood sugar level following on the administration of ragi was significantly less than that following on the administration of rice. Similar difference was noticed between rice starch and ragi starch but not with the hydrolysates of the two starches.

The probable significance of the above observation has been discussed.

Some aspects of the hair changes in kwashiorkor, by Narasinga Rao, B. S., and Gopalan, C., *Indian J. med. Res.*, 1957, **45** (1), 85.—Six amino acids were estimated in the hairs of a series of normal Indian children, of African cases of *kwashiorkor* in different stages of treatment, and of Indian children with *kwashiorkor* and simple under-nutrition. There is a significant reduction in the cystine content of the hair in cases of protein malnutrition, irrespective of the fact whether the hair is discoloured or not and that this abnormality is reversed after a few weeks of treatment with high protein diet. There is no correlation between dyschromatrichia and the content of amino-acids investigated. It would appear from the present investigation that cystine content of the hair may be a better indication of the severity of protein malnutrition than the hair discolouration.

Influence of cooking on the nutritional value of foods—Part I. Thiamine content of some cooked foods, by Pair, M. L., *Indian J. med. Res.*, 1957, **45** (1), 95.—Results of analysis of thirty-nine items of articles of food for their thiamine, ash and moisture content in their pre-cooked and cooked stages have been tabulated and shown graphically. Significant losses of thiamine occurred during washing of the articles of food, particularly vegetables, etc., before they were subjected to cooking. In the cooked articles of food studied, the percentage loss of thiamine when calculated on the basis of its content in the pre-cooked stage, varied from 2.6 to 57.5 per cent. No relationship was found between percentage thiamine loss and percentage ash in the article of food. Significance of this study of the composition of cooked articles of food has been discussed and its importance emphasized.

DAIRY

Production of infant food in India, by Subrahmanyam, V., *et al.*, *Indian Dairym.*, 1957, **9** (7), 276.—The need for producing infant food in India at places where milk is available in plenty, with a view to stop the import of nearly 3000 tons of infant foods has been stressed. The AA have standardised a method of preparing infant food from buffalo milk. The important steps in the production are (i) reduction of fat content of buffalo milk to 2.5 per cent, (ii) addition of phosphate buffer salts to react with ionised calcium and thus reduce curd tension, (iii) addition of sugar in order to reduce the protein content to 22 per cent and the fat content to 14 per cent, (iv) concentration, (v) addition of vitamins and homogenization (vi) drying in a Niro spray drier and (vii) packing in nitrogen atmosphere. Large scale trials to produce infant food at the Dairy of Kaira District Co-operative Milk Producer's Union at Anand were undertaken, an account of which is given. The composition of this infant food is given. Feeding trials carried out at Mysore on infants aged 4-9 months for periods ranging from 2-9 months have shown that the infants readily digested the food and grew normally. The product keeps well for one year at 37°C when packed under nitrogen atmosphere. A flow-sheet for the manufacture of infant food is also given.

K.L.R.

FISH

The tetrazolium bromide reduction test in assessing the quality of fish, by Kamasastri, P. V., *Curr. Sci.*, 1957, **26** (7), 214.—The tetrazolium bromide reduction test has been applied in assessing the quality of fish stored at room temperature. To the fish muscle suspension, triphenyl tetrazolium bromide solution is added at pH 7.2 and then incubated at 37°C. The time taken for the appearance of red colour is recorded. The TVN, TMA and bacterial count of the fish muscle are

determined. Observations made with different types of fish like sardines, mackerel and *Lethrinus* show that the time taken for the initial appearance of red colour is proportional to the extent of spoilage of fish stored at room temperature. In the case of fish, which were organoleptically fresh, the colour was visible in about 3 hours while in spoilt fish, the red colour appeared in less than 30 minutes. It has also been found that the intensity of colour was also related to the extent of spoilage. This reduction test is, therefore, of great use in studies on fish spoilage. The test, however, cannot be applied in the case of salt-cured fish, because the presence of even 1 per cent sodium chloride has an inhibitory effect on the time taken for the initial colour development.

K.L.R.

Amino-acid composition of some fishes, by Venkataraman, R. and Chari, S. T., *Indian J. med. Res.*, 1957, **45** (1), 77.—By applying the paper-chromatographic technique, the essential amino acid contents of five marine fishes have been studied. Fish proteins compare well as regards the amino-acid composition with the protein from other animal sources and supply in good quantities, lysine, leucine, valine, phenylalanine, methionine, threonine and tryptophane, the most needed in human dietaries. While the general pattern of the amino-acid make-up is the same in almost all the fishes studied, the absence of tryptophane in the sardine group of fishes is to be particularly noted. Pomfret, amongst the fishes studied, ranks high in its content of several of the amino acids especially in the leucines.

Semi-drying of prawns and its effects on the amino-acid composition, by Chari S. T. and Venkataraman, R., *Indian J. med. Res.*, 1957, **45** (1), 81.—The preservation of prawns by the process of semidrying does not alter its food value to any appreciable extent as could be seen by a comparison of the proximate chemical compo-

sition of the raw as well as the preserved prawns. The same holds good for the amino-acid picture of the proteins of the two samples, assessed by the paper-chromatographic technique. The results of amino-acid composition of the two samples show that both contain all the principal amino acids in fairly good amounts.

The studies in the nutritive value of Bombay fish, Part II. Isolation, purification, nitrogen distribution and the amino-acid make-up of fish proteins, by Valanju, N. N. and Sohonie, K. *Indian J. med. Res.*, 1957, **45** (1), 105.—A detailed method for the isolation and purification of fish proteins is described. The proteins prepared are light yellow to pale brown in colour and are almost without odour. The final yield obtained varies from 10 to 12 per cent muscle on the fresh weight basis. The proximate chemical analysis indicated that these proteins are 85 to 90 per cent pure. The distribution of nitrogen, the α -amino nitrogen and the amino-acid make-up of fish proteins was studied. The α -amino nitrogen in fish proteins varies from 65 to 75 per cent of the total nitrogen.

The studies in the nutritive value of Bombay fish, Part III. Essential amino-acid make-up of proteins of ghol and mandeli, by Valanju, N. N. and Sohonie, K., *Indian J. med. Res.*, 1957, **45** (1), 111. Essential amino-acids in proteins of mandeli and ghol were studied by chemical and microbiological methods. Both the fish proteins contained all the essential amino-acids in significant amounts.

FRUIT AND VEGETABLE PRODUCTS

Some aspects of food canning, by Littlejohn, G. S., *Indian Food Packer*, 1957, **11** (5-6), 7.—The various stages in the canning of a food material are: selection of the materials, preparation, blanching, filling, exhausting, double-seaming, processing, cooling and storage. The success of canning depends on the selection of materials which are in good and sound condition, preparing them skilfully under hygienic conditions, packing the correct weight of the product in hermetically sealed cans, processing under fixed conditions of time, temperature and pressure, cooling the cans carefully and storing them under proper conditions which will not cause deterioration of either the cans or their contents. The reasons as to why these various steps have to be carried out are given. The problems which arise at the different stages of canning and the methods to successfully overcome them have been described. The paper is of great importance and use to food canneries in producing a canned food product free from any defect whatsoever.

K.L.R.

OILS AND FATS

Gossypol in Indian cottonseed products, by Desikan, C. R., Rao, K. V. and Murthi, K. S., *Indian Oilseeds J.*, 1957, **1** (4), 216.—The dark colour of crude cottonseed oil and the toxicity of the uncooked meats to farm animals such as poultry and swine is due to

the pigments present in the glands of the seed. Gossypol is the principal pigment of cottonseed gland and free gossypol present in the oil and cake has toxic effects on animals. The free gossypol content in the oil and cake depends on the different steps *viz*: rolling, cooking and milling carried out in the processing of cottonseed. It also varies widely with the methods used for the extraction of oil. It is reported that the gossypol content is high in the case of expeller and solvent extracted oils and low in hydraulic-pressed oils, while it is high in hydraulic-pressed and solvent extracted cakes and low in expeller cakes. The AA, have, therefore, determined the gossypol contents of whole cottonseed, meats hulls, cakes and oils obtained in twelve pilot plant runs using two tons of nine commercial varieties of cottonseed produced in different states. Six other important cottonseed samples and their meats, and four samples of oils and cakes obtained from the mills have also been analysed for their gossypol content. The results recorded show that the gossypol content of 18 samples of cottonseed and meats varies from 0.43 to 0.88 per cent and 0.84 to 1.68 per cent respectively. The value in the case of 16 samples of expeller oils and cakes varies respectively from 0.04 to 0.80 per cent and 0 to 0.06 per cent. The limits of gossypol contents of the Indian cottonseed and its products and those produced in U.S.A. have been given for comparison.

K.L.R.

PART II (Foreign)

ANALYTICAL

The determination of sorbitol by Adcock, L. H., *Analyst*, 1957, **82** (975), 427.—Samples presented for determination of their sorbitol content often contain carbohydrates and the intramolecular ethers of sorbitol, usually referred to as the monoanhydrides of sorbitol. These interfere with the determination of sorbitol by oxidation with perio-

date. Separation of sorbitol from carbohydrates has been effected by degradation of the carbohydrates with alkali, followed by removal of the degradation products by means of ion-exchange resins; paper chromatography has been used for the separation of sorbitol from its anhydrides and other substances that react with periodate. Perio-

date procedures have been adapted to suit the various amounts of sorbitol separated by these methods which range from 1 to 400 μ g. Examples are given of the application of these procedures to food samples, technical products and biological materials.

Paper chromatography of phospholipides with solvent

mixtures of ketones and acetic acid, by Witter, R. F., *et al.*, *Arch. Biochem. Biophys.*, 1957, **68** (1), 15.—Mixtures of ketones and acetic acid, namely, 2-pentanone-acetic acid 30:2, 3-methyl-2-butanone-acetic acid 30:3, 4-methyl-2-pentanone-acetic acid 30:2, and 2, 6-dimethyl-4-heptanone-acetic acid 30:7 were found to give excellent separations of individual phospholipides on paper. It was possible to separate lysolecithin, sphingomyelin, phosphatidyl ethanolamine, lecithin, and phosphatidic acid in a unidimensional chromatogram. The individual phospholipides had to be present at concentrations from 10 to 25 $\mu\text{g.}/20\text{ ml.}$ in order to achieve good separations.

The preparation of glutamine from beet juice, by Rider, A. A. and McCollum, E. V., *Arch. Biochem. Biophys.*, 1957, **68** (1), 39.—A method is presented for the preparation of glutamine from beet juice. It involves the extraction of the glutamine from dried juice with an acetone solution of TCA, its precipitation from solution with anhydrous ammonia, and its purification with a solution of CaCl_2 in methanol followed by crystallization from ethanol-water. After one such crystallization, glutamine is obtained 80 per cent pure, contaminated with no ammonia and with only a trace of other amino acids. Further purification can be accomplished by repeated recrystallization. Added glutamine is recovered to the extent of about 83 per cent.

BAKERY

The role of lipids in baking—IV. Some further properties of flour lipids and defatted flours, by Cookson, M.A., *et al.*, *J. Sci. Fd. Agric.*, 1957, **8** (3), 105.—Flours recently examined have sometimes shown different characteristics from those previously described. Conflicting results on the breadmaking quality of defatted flours are attributed, from an examination of different flour-milling products, to differences in the

condition of the wheats constituting the grits and to the flour extraction rate, although the latter is not the controlling factor. Several methods of fractionating flour lipids and investigating the baking properties of various fractions are described. Countercurrent distribution of flour lipids is shown to be a useful systematic method of study, some of the fractions having markedly differing effects on bread properties. Further experiments on oxidative flour treatments have indicated that the flour lipid extracted by carbon tetrachloride is little affected by such treatments. The total lipid may, however, be involved in the mechanism of oxidative improvement. Dough and baking tests on underfatted flours and defatted flours in which the extracted lipids have been replaced indicated that the original nature of the flour lipid cannot be fully restored. The ultra-violet absorption spectra of the lipids from different wheat-milling products and breads are described and it is shown that such spectra might be used to indicate (a) the bran content of a flour and (b) whether a treated flour has been used in bread production.

It is clear from the complicated picture emerging from the results hitherto obtained, that until far more is known of the constitution of flour and the effect of the many factors contributing to its constitution, experimental dough and baking tests remain the best means of assessing flour quality for bread-making.

Effect of baking on the nutritive value of proteins in wheat bread with and without supplements of nonfat dry milk and lysine, by Sabiston, A. R. and Kennedy, B. M., *Cereal chem.*, 1957, **34** (2), 94.—The protein quality of whole-wheat bread and of the unbaked ingredients containing 0, 3, 6 and 12 per cent nonfat dry milk and 0.166 per cent *l*-lysine, and of white bread containing 6 per cent nonfat dry milk, was determined by rat growth studies. Increasing quantities of milk gave increased protein efficien-

cy ratios. The quality of the white bread containing nonfat dry milk was better than that of the whole-wheat water bread and somewhat inferior to that of whole-wheat bread containing 3 per cent nonfat dry milk. Whole-wheat bread containing 0.166 per cent *l*-lysine equivalent to the amount of lysine in 6 per cent nonfat dry milk had a protein efficiency ratio close to that of the bread containing 6 per cent nonfat dry milk, which was not essentially different from that of whole-wheat bread baked without lysine but supplemented by lysine in the diet. The protein efficiency of all of the breads was approximately 20 per cent less than that of their unbaked ingredients. Protein value of bread dried in a dehydrator at temperatures up to 50°C was not significantly different from that of bread dried at room temperature.

Studies on the changes in the water-soluble carbohydrates of chapaties during aging, by Nath, N., Singh, S and Nath, H. P. *Food Res.*, 1957, **22**, 25.—With a view to study the keeping quality of chapaties, the AA have investigated the changes in water-soluble carbohydrates of chapaties stored under the following conditions: (a) packaged in a water-impervious plastic bag and stored at room temperature (28°C) and at refrigerator (8°C) for 72 hours; (b) packaged in accordance with the method developed at the Defence Service Laboratory, New Delhi, for making longer keeping chapaties and stored at room temperature for about 6 months; and (c) wrapping 10 chapaties together with a piece of cloth and storing at room temperature. For purposes of comparison, relative changes in the saccharides of whole wheat flour on storage have also been reported.

Results indicate that the conditions of storage have much influence on the water-soluble constituents. There is decrease in solids and polysaccharides of aqueous extract of chapaties after storage for 24 hours under different conditions, whereas reducing sugar in aqueous extract shows variable changes.

Storing chapaties for 6 months at room temperature results in a definite and pronounced increase in the reducing sugar content of the aqueous extract of chapaties while polysaccharides show an appreciable decrease.

Paper chromatographic analysis of sugar in water extract of chapaties stored for 6 months shows that the increase in the reducing sugar is due to increase in the concentration of glucose and the formation of fructose.

J.S.P.

BIOCHEMISTRY AND NUTRITION

Essential amino-acid deficiency and enzyme activity, by Van Pilsum, J. F., *et al.*, *Arch. Biochem. Biophys.*, 1957, **68** (1), 42.—Complete amino-acid diets and diets deficient in either tryptophan, isoleucine, or phenylalanine were fed to rats by both *ad libitum* and force-feeding techniques. The *in vitro* activities of kidney D-amino-acid oxidase and of liver arginase, aconitase, catalase, and xanthine oxidase were measured.

The activities per milligram tissue nitrogen of arginase, aconitase, and D-amino-acid oxidase did not change in the deficient animals. The activity of catalase and xanthine oxidase per liver decreased in the deficient animals irrespective of the maintenance of liver nitrogen by force-feeding.

The results are compared with those obtained by other investigators when low protein or protein-free diets were fed. It is concluded that the influence of these deficiencies depended upon the relative priority of the synthetic systems for the amino-acid pool.

The digestibility of adult fowls of wheat fine middlings, maize germ meal, maize gluten feed, soya-bean meal and groundnut meal, by Bolton, W., *J. Sci. Fd. Agric.*, 1957, **8** (3), 132.—The digestibility coefficients for the various carbohydrate fractions in wheat fine middlings, maize germ meal, maize gluten feed,

soya-bean meal and groundnut meal were determined. These fractions included the conventional nitrogen-free extractives and crude fibre, and also sugar, starch, pentosan, cellulose and lignin. Sugar and starch were completely digested, cellulose and lignin were indigestible whilst the digestibility co-efficient of the pentosan varied from 5.6 in maize germ meal to 36.5 in wheat fine middlings.

Quality evaluation and chemical composition of soya sauce, by Onaga, D.M., *et al.*, *Food Res.*, 1957, **22**, 83.—Data on the chemical composition and organoleptic quality of some samples of California soya sauce are presented, compared and discussed. Salt, acidity and nitrogen content are important factors influencing flavour acceptance. Amino-acids in soya sauce, as determined by two-dimensional paper chromatography are reported. A rapid ion-exchange method to remove salt from soya sauce for paper chromatographic studies is described. The importance of various chemical constituents to flavour is discussed.

J.S.P.

COLD STORAGE

Changes in light reflectance and ascorbic acid content of foods during frozen storage, by Guerrant, N. B., *J. Sci. Fd. Agric.*, 1957, **5** (3), 207.—Reflection measurements made by a General Electric recording spectrophotometer and reduced ascorbic acid values determined by a conventional method of assay on samples prepared in a uniform manner from frozen fruits and vegetables stored at +10°, 0°, and -20° F. for 12 months reveal that the storage temperature had a very definite effect on the capacity of the foods to reflect visible light and on the reduced ascorbic acid content of the foods. The greatest change in reflectance and in vitamin content occurred in foods that had been stored at the higher temperatures. Changes in the reflectance of the foods during frozen storage seem to parallel changes in ascorbic acid content.

FRUIT AND VEGETABLE PRODUCTS

The organic acid metabolism of apple fruits: Changes in individual acids during growth on the tree, Hulme, A. C. and by Woollorton, L. S. G., *J. Sci. Fd. Agric.*, 1957, **8** (3), 117.—Organic acids present in apple pulp and peel at various stages of maturity have been studied using ion-exchange and silica-gel chromatography.

The concentration of quinic acid has been found to fall rapidly throughout the development period while that of malic acid reaches a peak at 50-60 days after the fall of the petal. Citric acid which is present in much smaller amounts than the other two acids, shows considerable changes in amount and concentration.

S.R.

The amino-acids of apple juices and ciders, by Burroughs, L. F., *J. Sci. Fd. Agric.*, 1957, **8**, (3) 122.—Asparagine, aspartic and glutamic acids have been found by using paper chromatography to be the principle amino-acids in apple juice. Serine, α -alanine, γ -amino butyric acid, valine, isoleucine, and methylhydroxyproline are present in medium to small amounts, while ten other amino acids have been found to be present sometimes in trace amounts.

The amino acid content of ciders have been found to be extremely small which consisted usually of aspartic and glutamic acids, methylhydroxyproline, an unidentified peptide and traces of several other amino-acids and possible peptides. Yeast autolysis caused a marked increase in the amino-acid content of of a cider left on its lees.

The presence of nucleotide material in juices and cider has been indicated.

S.R.

Metallic components of fruit juices—I. Copper as a factor affecting sedimentation in bottled apple juices, by Kieser, M. E., Pollard, A. and Timberlake, C. F., *J. Sci. Fd. Agric.*, 1957, **8**

(3), 151.—Storage deposits in bottled pasteurized apple juices have been found to consist mainly of degraded juice phenolic compounds, protein material and ash components. The presence of copper in low concentrations promotes sedimentation and leads to the formation of deposits of high copper content; the effect of copper is partly inhibited by the presence of sulphur dioxide. Of the other metals tested only tin was found to increase sedimentation and to appear in significant amounts in the deposits. Studies of juice components in isolated systems suggest that the presence of copper is a main factor in deposit formation and that copper catalyses the degradation of juice phenolic substances, particularly of leuco-anthocyanins and *epi*-catechin, leading to their precipitation. A comparison is drawn between the storage deposits of apple juices and the non-biological hazes of beer.

Metallic components of fruit juices—II. The nature of some copper complexes in apple juice by Timberlake, C.F., *J. Sci. Fd. Agric.*, 1957, 8 (3), 159.—The interaction of cupric copper with the organic acid, amino-acid and phenolic components of apple juices had been investigated in juices and model systems. Copper is mainly complexed with malic acid and the dissociation constant of this complex has been calculated; the proportion of copper complexed with amino-acids is small. Copper forms soluble complexes with the phenolics at the pH of juices, with reduction of cupric copper to the cuprous state and leading to the precipitation of copper and partly degraded phenolics. The significance of these findings is discussed in relation to the storage behaviour of apple juices.

The jelly strength grading of pectins for use in jam manufacture, by Olliver, M., Wade, P. and Dent, K. P., *J. Sci. Fd. Agric.*, 1957, 8 (3), 182.—Gels prepared from rapid-set powder pectins by the 'acid-in-boil' procedure may vary in strength, as

measured by the Ridgeline, according to the type of sugar used. This variability, not generally shown by slow-set powder or by liquid pectins can be overcome by adding surface-active agents or fruit juices. A method for determination of grade of pectins is proposed which gives results in line with those obtained by the 'acid-in-glass' procedure. The reliability of the proposed method for jam manufacturing control has been confirmed.

Recent advances in the enzymatic hydrolysis of pectic substances, by Demain, A. L. and Phaff, H.J., *Wallerstein Lab. Commn.* 1957, 20 (69), 119.—The present review has emphasised the complexity of enzyme systems capable of glycosidic hydrolysis of pectic substances and an attempt has been made to classify the pectic enzymes described under a great variety of names into a simple logical system. Certain enzymes are not sufficiently characterised to be placed in a well-defined group. The results presented show clearly the great importance of using substrates that are well defined and enzyme preparations containing only a single pectic enzyme component. The proposed classification makes use of the prepared substrate (highly esterified pectin *versus* pectic acid), mechanism of attack (random splitting *versus* end group attack), optimum pH and extent of hydrolysis of the polyuronide chain. The present status of 'protopectinase' and classical 'fungal polygalacturonase' has been discussed critically. In addition, the current knowledge of microbial and plant pectin-esterases has been reviewed as well as certain application of pectic enzymes in the light of the newer knowledge.

Role of amino acids in the browning of orange juice, by Joslyn, M. A., *Food Res.*, 1957, 22, 1.—A comprehensive review on the browning of foods in general, and specially on the browning of orange juice is presented and the apparent discrepancies explained. New data are presented on the

subject. The apparent decrease in lysine and glutamic acid occurring in later stages of browning of orange juice stored in presence of air for 4 years at room temperature and some evidence for the presence of ninhydrin positive amino acid compound is reported.

Data presented on the oxidative browning of ascorbic acid—amino-acid—sugar system indicates that ascorbic acid is the most reactive component and that glucose and fructose inhibit its browning. Amino-acids in the initial stages inhibit browning, but in later stages increase it. The concentration of ascorbic acid initially present has a marked effect on the rate and extent of browning of ascorbic acid solutions.

J.S.P.

Quality in baked sweet-potatoes affected by varieties and post-harvest treatments, by Jenkins, W. F. and Gieger, M. *Food Res.*, 1957, 22, 32.—Physico-chemical changes in different varieties of sweet-potatoes during baking and storage are reported. Varietal differences in organoleptic quality of baked sweet-potatoes are discussed.

J.S.P.

Effect of storage and of boiling on the ascorbic, dehydro-ascorbic and diketogulonic acid contents of potatoes, by Leichsenring, J. M., *et al.*, *Food Res.*, 1957, 22, 37.—Following several methods of cooking, the relative quantities of ascorbic, dehydro-ascorbic and diketogulonic acids in 2 varieties of potatoes (*Chippewa* and *Triumph*) under various conditions of storage have been reported.

J.S.P.

Effect of baking and of pressure-cooking on the ascorbic, dehydroascorbic and diketogulonic acid contents of potatoes, by Leichsenring, J. M., *et al.*, *Food Res.*, 1957, 22, 44.—Effect of 2 methods of cooking and of refrigeration after cooking on the ascorbic, dehydroascorbic and diketogulonic acid contents of a number

of varieties of potatoes have been investigated. Baking tests were conducted on 3 varieties while cooking in a pressure saucepan was tested on 2 varieties.

J.S.P.

The carotenoids of ruby red grape fruit, by Curl, A. L., and Bailey, G. F., *Food Res.*, 1957, **22**, 63.—The carotenoids of Ruby Red grape fruit pulp and peel have been examined by counter-current distribution followed by chromatography. The two principal pigments of the pulp were found to be lycopene and beta-carotene, accompanied by lesser amounts of phytofluene and zeta carotene. Phytoene was a major constituent of the pulp and was the leading constituent of the peel, followed by phytofluene.

Counter current distribution showed the presence of both monols and diols (plus polyols) in much smaller amounts than the hydrocarbons. On chromatography, these fractions from both pulp and peel were found to be rather complex, about 13 constituents being found in both pulp and peel carotenoids. Apparently most or all of the xanthophylls found in oranges and tangerines were present as minor constituents.

J.S.P.

INSECTICIDES

Determination of ethylene dibromide in fumigated fruit, by Kennett, B. H. and Huelin, F. E. *J. agric. Fd. Chem.*, 1957, **5** (3),

201.—Ethylene dibromide is recovered from fumigated fruit by steam distillation and extraction with benzene. It is decomposed with sodium hydroxide in ethyl alcohol-benzene solution, and the liberated bromide is oxidized to bromate, which is determined iodometrically.

The susceptibility to insecticides of laboratory cultures of an insect species, by Holborn, J. M., *J. Sci. Fd. Agric.*, 1957, **8** (3), 182.—Adult *Calandra* of the same age but some reared from a wild strain and the others from a laboratory strain were used in tests with pyrethrin powders. The laboratory strain was found to be between three and a half and six and a half times as susceptible to pyrethrins as the wild strain, which was not appreciably less susceptible to synergized pyrethrins (pyrethrins and piperonyl butoxide) than was the laboratory strain.

Several strains of adult *Tribolium* of the same age showed differences in susceptibility to γ -BHC, pyrethrins and, to a lesser degree to synergized pyrethrins. These strains were developed from cultures from different laboratories.

γ -BHC was found to be four times, and pyrethrins three and a half times, more effective against the most susceptible strain of *Tribolium* than against the least susceptible strain.

Differences in susceptibility are believed to be due to differences in vigour.

MICROBIOLOGY

Carotene production by penicillium sclerotiorum, by Mase Y., Rabourn, W. J. and Quackenbush, F. W., *Arch. Biochem. Biophys.*, 1957, **68**, (1), 150.—A strain of *Penicillium sclerotiorum* (NRRL 2074) was found to be a good carotene producer in standing culture on wort medium in light. This fungus strain produced more than 1 mg. of total carotene per gram of dry mycelium, of which approximately 65 per cent was β -carotene and approximately 25 per cent was γ -carotene. In addition, as minor pigments, α -carotene, three *cis* isomers of β -carotene, two *cis* isomers of γ -carotene, and α -carotene were identified. A second strain *Penicillium sclerotirum* (NRRL 2076), also produced carotenoid pigments, but it was inferior to NRRL 2074.

GENERAL

A re-evaluation of biological potency of beta carotene, by Barnett, H. M. and Espoy, H. M. *Food Res.*, 1957, **22**, 15.—The results of biological assays conducted indicate that pure all-trans betacarotene has biological activity of 2,200,000 to 2,500,000 U.S.P. units per g. in terms of the U.S.P. reference vitamin A acetate standard. It, therefore, seems very doubtful that carotene splits in such a manner as to give only one molecule of vitamin A. Accordingly, it is believed that a re-evaluation of the accepted vitamin A potency of beta-carotene is warranted.

J.S.P.

LIST OF ABSTRACTORS

| | | |
|----------|---|---------------------|
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Dalda

and its place in the diet

In a recent address on "Fundamental Problems of Vitaminology," Prof. Wilhelm Stepp, Emeritus Director of the Munich Medical Clinic, observed: "Even authoritative writers hold that in this epoch when foodstuffs abound, vitamin deficiencies are no longer seen. This is a fundamental error."

Prof. Stepp cited as an example the U.S.A., one of the well-fed nations of the world. "The addition of vitamins to the flour used for bread now practised in the U.S.A. goes on to show that insufficient vitamins seem to be a great peril which must be avoided at all costs. In effect it is not possible to buy bakery flour in the U.S.A. which has not been reinforced with vitamins and some minerals."

If this is the case in America the condition must be far worse in a country like India where the intake of milk, milk products and other animal foods is extremely low. To quote from the special report No. 27 published by the Indian Council of Medical Research: "According to Health Bulletin No. 23 (1951), issued by the Nutrition Research Laboratories, Coonoor, *vitamin A deficiency is the single factor responsible for a large number of nutritional deficiency diseases*. The daily allowances for an adult are in the neighbourhood of 3,000 to 4,000 I.U. of vitamin A. Animal foods, which are rich in vitamin A, are however, many times more expensive; hence this rich source of vitamin A cannot be utilised."

With a view to making good a part of the vitamin A deficiency in this country the Food Fortification Sub-Committee of the Indian Council of Medical Research had recommended that the vitamin A content of vanaspati should be raised to 700 I.U. per oz. thus making available to the people a good and nourishing fat at an econo-

mical price. This has been done with Dalda.

Dalda is a pure cooking fat made out of vegetable oils according to strict Government specifications. The ordinary oils of everyday use are refined, hydrogenated and enriched with 700 I.U. of vitamin A per oz. and 50 I.U. of vitamin D per oz. By virtue of this enrichment the vitamin content of Dalda is now the same as that of good quality ghee.

Dalda is not a substitute for but an alternative to ghee. Fats like butter and ghee are good but their supply is far short of requirements and they are too expensive for the everyday use of most people. Further, the consumption of milk as milk is more beneficial than the consumption of ghee which is a product of milk, as then the consumer gets the animal protein as well as the calcium and vitamins. In most western countries people are increasingly consuming milk as milk. This should be the ideal trend in India also.

In addition to being a fat enriched with the two essential vitamins, Dalda is easily digested and utilised by the body on account of its low melting point. The standards of quality laid down for the manufacture of this product are so high that it compares favourably with its other counterparts such as "shortening" and "margarine" used extensively in the United States, England and other European countries. Each ounce of Dalda yields 250 calories, as much as 1 oz. of any good quality ghee and over twice as much as an ounce of wheat or rice.

Dalda is, therefore, a very valuable addition to the average Indian diet which is so often lacking in essential nutrients, particularly



FOOD SCIENCE

BULLETIN OF THE CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE

INFANT FOOD

India has been dependent on imports of Infant Foods and other products of this nature such as malted milk (with or without cocoa), whole and skimmed milk powders. The imports of Infant Foods alone have been of the order of 3,000 tons a year and the estimated cost of all food products based mainly on milk can be reckoned at several crores of rupees every year. The difficulty of starting any large scale production of these products in India has been on account of the general belief that there is no surplus milk of the right quality (cow's milk) in any part of the country. Though sufficient quantity of cow's milk is not produced, surplus buffalo milk is available in certain milk pockets of the country such as Gujerat, Punjab and parts of U. P. According to the process developed at the Central Food Technological Research Institute, it is possible to manufacture infant food even from buffalo's milk which has been made as easily digestible by infants as cow's milk. This has been amply demonstrated by feeding trials. Consequently, it is now being increasingly felt that there is scope for the infant food industry in India. Again, more recent experience has shown that when the demand for the milk is established, its production in increased quantity will be duly forthcoming. The success of the Kaira District Co-operative Milk Producers' Union at Anand is an outstanding example in this respect. The production of milk in that region has now been so well organised that if any additional supply of fluid milk is required, it will be possible to obtain it without much effort. Even as it is to-day, there is scope for collecting about 3,00,000 lb. of buffalo milk per day during the favourable months and at least half that quantity during other months. The supply of fluid milk to the City of Bombay is about 60,000 lb. per day so that the remaining quantity can be easily utilised for processing into suitable products. Efforts to increase

milk production on similar organised lines in different parts of the country both for city supplies and for developing milk processing industries are being actively pursued by the Ministry of Food and Agriculture with the aid of different International Organisations who have supplied equipment, technical advice and other facilities.

During the past two years, this Institute has been regularly producing, from buffalo milk, a humanised form of infant food which has been fed for long periods to infants kept under systematic medical observation. It has now been established that the production of infant food from buffalo milk can be taken up successfully. This milk is partially defatted to the required fat content so as to facilitate easy assimilation by infants. The separated cream can be packed as such or converted into high grade edible butter or *ghee*. Spray drying has facilitated easy dispersion and dissolution of the finished product. Packing under nitrogen has helped to preserve the freshness and to enhance the keeping quality of the product. Fortification with essential vitamins has made it equivalent to the most advanced type of humanised infant food. Large-scale trials carried out by the Institute with this product at the Kaira District Co-operative Milk Producers' Union, Anand, have shown the possibility of manufacturing it economically in the country to prevent import and save on foreign exchange. Thus it is reasonable to expect that before long it will be possible to manufacture this product so as to meet a major part of the requirements of the country. The success of the first venture in the manufacture of the Infant Food in India will depend to a large extent not only on the organized production but also on the active co-operation and support from the people (industry and trade) of the country. The role of the State aid is undoubtedly very important.

INFANT FOOD FROM BUFFALO MILK

I. Effect of different treatments on curd tension

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Processed infant foods which are used as partial or complete substitutes for mother's or bovine milk may be broadly classified under: (1) whole milk powder (full cream milk powder), (2) milk powder with reduced fat content, (3) milk powder with added lactose or other carbohydrates, (4) milk powder in which the proportion of proteins is altered more or less to resemble those of dried human milk (humanized milk foods)¹. The milks reconstituted from infant foods have, in general, a lower curd tension than freshly boiled cow's milk and hence are more readily digested by infants¹. All the infant foods available on the market are being manufactured at present from cow's milk. Buffalo milk has not so far been used for this purpose². Considerable amount of work has been done on the factors affecting the curd tension of cow's milk³. The available data indicate that the ingredients of milk directly affecting the curd tension are casein^{4,5} and ionised calcium^{6,7}. Doan and Welch⁴ showed that curd tension is a linear function of the casein content when there is sufficient ionised calcium. Lyman *et al*^{6,7} reported that the removal of the ionised calcium present in

milk by the base-exchange process reduces considerably the curd tension of milk. The curd tension of milk can also be lowered by various other treatments such as, boiling^{4,8,9}, acidification, homogenisation^{10,11}, addition of phosphates and citrates³. During the course of our investigations on the preparation of infant food from buffalo milk, the effect of various treatments on the curd tension of buffalo milk were studied. The results of these studies are reported in this paper.

Materials and Methods

The milk samples used in the present study were obtained from a local dairy from 'Sindhi' cows and 'Murrah' buffaloes. The average chemical composition of the samples used in the experiment is given in Table I. The composition of the milk was fairly constant during the course of the experiment.

TABLE I. Average composition of milk used for curd tension studies

| | | | Fat | Solids not fat | Calcium | Protein (N × 6.25) |
|--------------|-----|-----|-----|----------------|---------|--------------------|
| Cow's milk | ... | ... | 4.1 | 9.0 | 0.12 | 3.6 |
| Buffalo milk | ... | ... | 7.3 | 9.2 | 0.18 | 4.0 |

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A number of methods have been suggested for measuring the tension or hardness of the milk curd. The method used in the present study is similar in principle to that suggested by curd tension committee of the American Dairy Science Association¹². A simple type of curd tension meter (Fig. I) was employed. It consists of three sharp stainless steel knives of 1" × ¼", welded in the form of 'H'. A thin vertical rod is attached to the centre of the middle knife. The other end of the rod is bent in the form of a hook which is attached to the thread carrying the pan over a frictionless pulley.

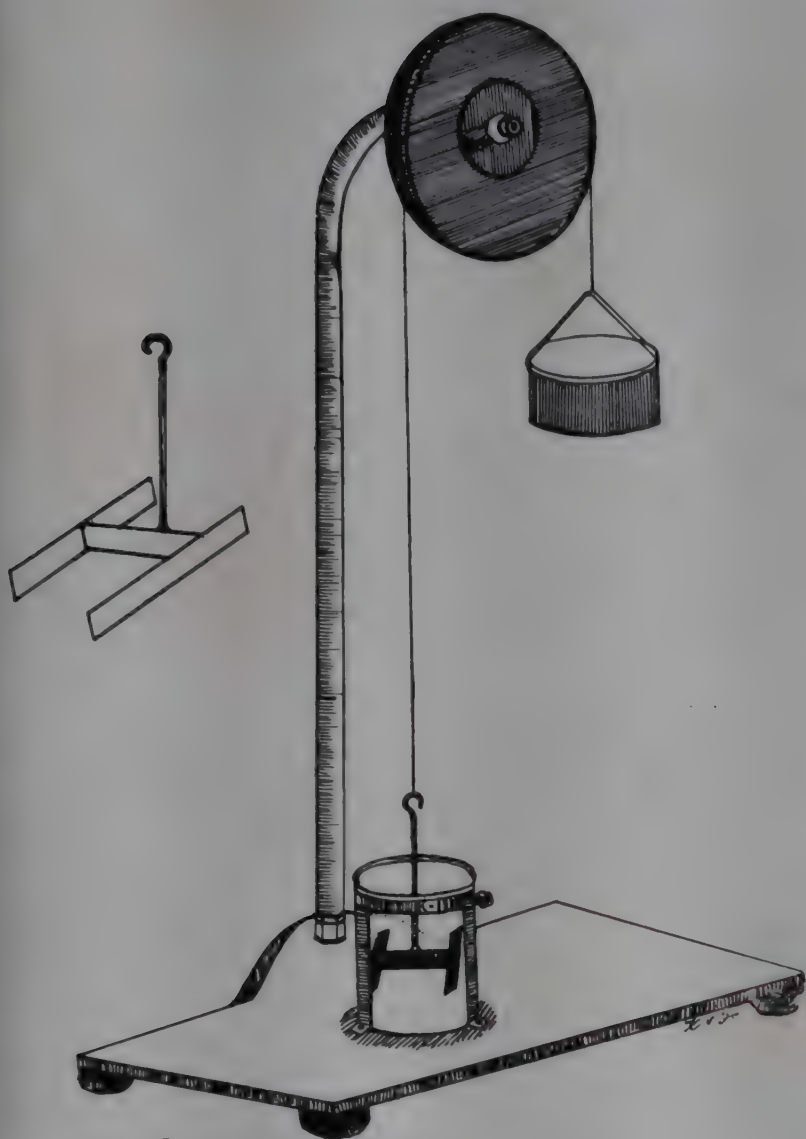


Fig. 1

The curd tension of the milks was determined as follows: In a series of uniform beakers of size 7 cm. \times 4.5 cm., 50 ml. of milk to be tested were placed and pre-warmed to 37°C. The curd tension knives were placed in the beakers and 2 ml. of 0.1 per cent rennet (Merck) solution were added rapidly to all the beakers. The milks in the beakers were stirred immediately and all the beakers were placed in a thermostat at 37°C for three hours. The beakers were then taken out of the thermostat. The pan was loaded with lead shots, till the curd tension knife cuts its way through the curd. The weight of the lead shots expressed in grams was taken as a measure of the tension of the curd. All the measurements were made in duplicates which generally agreed within 10 per cent variation.

Experimental

It has been shown by earlier workers that in the case of cow's milk, boiling and addition of citrates and phosphates brings about a reduction

in the curd tension of milk. The effect of similar treatments on the curd tension of cow's and buffalo milk was studied. The results are given in Table II.

TABLE II. *Effect of different treatments on the curd tension of the milk of cow and buffalo*

| Sl. No. | Treatment | Cow's milk | | Buffalo milk | |
|---------|---|-------------|--------------|--------------|--------------|
| | | Fat content | Curd tension | Fat content | Curd tension |
| 1 | Untreated (Raw) ... | 4.1 | 23.3 | 7.3 | 40.2 |
| 2 | Partially Skimmed (Raw) ... | 2.9 | 25.5 | 2.9 | 44.0 |
| 3 | Skimmed (Raw) ... | 0.5 | 28.0 | 0.5 | 52.0 |
| 4 | Heated to 85°C for 3 minutes | 4.1 | 8.2 | 7.3 | 10.75 |
| 5 | Boiled for 3 minutes | 4.1 | 6.75 | 7.3 | 9.50 |
| 6 | Partially skimmed, and heated to 85°C for 3 minutes | 2.9 | 4.5 | 2.9 | 6.5 |
| 7 | Partially skimmed, phosphate buffer (0.08% Na_2HPO_4 + 0.06% NaH_2PO_4) added and heated to 85°C for 3 minutes | 2.9 | 3.5 | 2.9 | 6.0 |
| 8 | Partially skimmed, sodium citrate at 0.1% on weight of fluid milk added, and heated to 85°C for 3 minutes | 2.9 | 4.5 | 2.9 | 6.5 |

These results have shown that buffalo milk behaves to various treatments in the same way as cow's milk.

Further it will be seen from Table II that the curd tension of raw buffalo milk is higher than that of cow's milk. Skimming brings about a slight increase in the curd tension value of the two milks. Boiling the milk brings about a marked reduction in the curd tension of cow's as well as buffalo milk. The addition of citrate or phosphate to boiled milk causes a further slight reduction in the curd tension of the two milks.

The results reported above clearly indicate that heating lowers considerably the curd tension of buffalo milk and the heated buffalo milk, after adjustment of composition, will be readily digestible by infants. The curd tension of infant food prepared from buffalo milk is reported in a later communication.

Summary

1. A simple curd tension meter for determining the curd tension of milk has been described.

2. The effect of heat and addition of phosphates and citrate on the curd tension of buffalo milk has been studied and it has been found that the curd tension of buffalo milk is reduced to a very low figure as a result of heat processing and addition of phosphates or citrate.

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INFANT FOOD FROM BUFFALO MILK

II. Standardization of Conditions for the Preparation

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India is at present importing about 3,000 tons of infant foods, based mainly on milk. This is apart from the whole and skim milk products and other milk foods, containing malt extract, cocoa and such other additions¹. Only recently steps have been taken for establishing a factory at Anand for the production of whole and skim milk powder². There is also an urgent need for developing the infant food industry to meet the requirements of the growing infant population³.

India ranks third in the world in the matter of total milk production; the annual production in 1954 amounted to 19,318 thousand tons⁴. On account of the large population, the average *per capita* daily availability of milk is, however, only about 5 ounces. This varies from one state to another, being as high as 18.8 ounces in Saurashtra and as low as 1.3 ounces in Travancore⁵. The major milk producing States are Punjab, Uttar Pradesh, Bihar, Baroda, Saurashtra and Rajasthan. It is also important to note that in many of these States, the production of buffalo milk is more than that of cow's milk⁵. Buffalo milk is being used at present only to a limited extent for feeding infants.

A good deal of work has been done in different countries on the choice of equipment and on the standardization of conditions for the production of infant foods from cow's milk⁶. In view of the fact that at present only buffalo milk is available in surplus quantities in certain parts of the country, investigations were undertaken to standardise the conditions for the production of infant food from buffalo milk and to assess its value as an infant food.

In the present investigation, the following aspects of the problems have been studied: (1) standardization of the formula and the process for the preparation of infant food, (2) the curd tension of infant food prepared from buffalo milk as compared with some proprietary infant foods, (3) the influence of varying bacterial contamination of raw milk on the bacterial count of infant food, and (4) the effect of collection of raw milk in brass vessels on the copper content of infant food.

Materials and Methods

The milk used in the present study was obtained from *murrah* buffaloes of a local dairy. The range of variation in the chemical composition of raw milk samples as observed during

the course of the experiment is given in Table I.

TABLE I. *Composition of buffalo milk used for the preparation of infant food*

| Constituents | | Minimum % | Maximum % | Average % |
|--------------|-----|-----------|-----------|-----------|
| Total solids | ... | 16.49 | 17.35 | 16.80 |
| Fat | ... | 7.1 | 8.0 | 7.5 |
| S.N.F. | ... | 9.20 | 9.40 | 9.30 |

The fat, solids not fat and acidity of milk were determined according to the standard methods of A.O.A.C.⁷. The methylene blue reduction time, plate count and *B-coli* count in raw, condensed and dried milk samples were determined by the methods of American Public Health Association⁸. The solubility of the product was measured by the method described by Howat, Smith, Waite and Wright⁹. Copper in milk powder was determined by the method of Sylvester and Lampitt¹⁰. The curd tension of the reconstituted milk from the infant food was determined by the method given by Chandrasekhara *et al*¹¹.

Experimental

Standardization of the formula for infant food: Whole milk powder prepared from cow's milk contains about 25 per cent protein. Proprietary infant foods available in the market have a widely varying protein (14 to 27 per cent) and fat (15—25 per cent) contents¹². In view of the fact that the protein and fat requirements of infants under tropical conditions are somewhat lower than the standards suggested for temperate climates¹³, it was felt that an infant food with a protein content of 20—22 per cent and fat content of 14 per cent may be more suited for infants in our country. The fat content was purposely reduced to that of half-cream milk powder so as to facilitate easy digestion of the food by the infants. The food on reconstitution with 7 times its weight of water will yield a milk having 2.5 per cent protein and about 1.8 per cent fat.

Process for the Preparation of Infant Food

The preparation of the infant food consisted of the following steps: (1) collection and examination

of the quality of fluid milk (2) adjustment of fat content by skimming (3) pasteurisation (4) adjustment of composition and concentration (5) homogenisation and drying. The process is briefly described below:

The milk was received in the laboratory in clean sterile closed aluminium cans from the dairy within three hours of milking. Immediately on receipt, a sample was taken with usual precautions for bacteriological examination and kept in the refrigerator. Another sample was removed for chemical analysis. About two thirds of the milk was skimmed using a hand cream separator. The skimmed milk was mixed with about half its volume of whole milk so that the fat content was approximately 2.5 per cent. A buffer solution of pH 7 containing disodium hydrogen phosphate and sodium dihydrogen phosphate was then added. This helps to stabilise the milk during concentration and also lower the curd tension of the milk¹¹. The milk was pasteurized by heating in a steam jacketed stainless steel vessel at 185°F for 5 minutes. This treatment besides pasteurising the milk, also helps in developing sulphhydryl groups in the milk which act as anti-oxidants for the milk fat in the powder¹⁴.

Sugar in the proportion of one part of sugar to 2.5 parts of total milk solids was added in the form of a syrup which had been boiled for 5 minutes to destroy the bacteria present. After mixing, the milk was evaporated to about 40 per cent solids in a stainless steel vertical ascending and descending flow film-evaporator working under a vacuum of 26". Weighed amount of water soluble and fat soluble vitamins, (proportion mentioned in table II) dissolved in a small quantity of water and cream respectively, were then added to the hot concentrated milk. The condensed milk was then homogenised using a homogeniser and then dried in a Niro laboratory model spray drier. The temperature of the inlet air was 392°F and that of the outlet air about 210°F. The powder was collected in clean air tight tins from the bottom of the drying chamber. Samples of the powder were removed with the usual precautions, for bacteriological and chemical analysis. The bulk of the samples were kept in cold store (4°C) for 24 hours and packed in 8 oz. cans under nitrogen or compressed air for storage

studies. The chemical composition of the infant food is given in table II.

TABLE II. *Average chemical composition of the infant food*

| Constituents | | | Per cent | Vitamins added to 100g. of the powder |
|-------------------------|-----|-----|----------|---------------------------------------|
| Moisture | ... | ... | 2.8 | Vitamin A (I.U.) 1,500 |
| Protein | ... | ... | 21.5 | Vitamin D (I.U.) 400 |
| Fat | ... | ... | 14.5 | Thiamine (mg) 1.0 |
| Carbohydrate (by diff.) | ... | ... | 56.4 | Riboflavin (mg) 0.5 |
| Minerals | ... | ... | 4.8 | Niacinamide (mg) 5.0 |
| Calcium | ... | ... | 0.98 | Pyridoxine (mg) 0.6 |
| Phosphorus | ... | ... | 0.96 | Vitamin B ₁₂ (μg) 2.0 |
| | | | | Vitamin C (mg) 30.0 |

The influence of varying bacterial and copper contamination of raw milk on the bacterial count and copper content of the infant food

Under tropical conditions, fluid milk is readily contaminated by bacteria. Further, the hygienic conditions of the dairy and of the collecting vessel and the time lag between the collection and delivery of milk at the dairy, will also influence considerably the bacteriological quality of milk. It was, therefore, considered desirable to investigate the effect of bacterial contamination ordinarily occurring in dairy milk on the bacterial count of dried infant food. For comparison, infant food was prepared from milk having a low bacterial count collected in sterilised stainless steel vessels under carefully controlled hygienic conditions. In a third experiment the effect of addition of extraneous materials like straw to milk (a practice followed in some places to prevent the spilling of milk due to vibrations during transit) on the bacteriological quality of the milk and the infant food, was also investigated. The methods of collecting the three types of milk are described below:

(a) *Milk collected in sterilised stainless steel vessels:* The udders of the buffaloes, were thoroughly washed with warm water before milking and the milk was collected in sterilised stainless steel vessels. The vessels were closed

with a lid immediately after collection, chilled in an ice box and transported to the Institute.

(b) *Dairy Milk:* The milk was collected in aluminium cans as usual under the dairy conditions. The time taken for the collection of milk and its delivery at the Institute was 3 hours.

(c) *Milk transported with added straw:* In some places, milk collected by individual farmers in villages is transported to nearby towns after the addition of paddy straw to the container to prevent the spilling of milk during transit. To the milk collected as usual from the dairy in an aluminium can, a small bundle of paddy straw was added. The time taken for the collection of milk and its delivery to the Institute was 3 hours.

(d & e) *Collection of milk in brass vessels on the copper content of the infant food:* Data available in the literature show that contamination of fluid milk with copper affects adversely the shelf-life of the milk powder¹⁵. In India brass vessels are commonly employed for milking in the villages and the milk is kept in such vessels for 1-3 hours. It was, therefore, considered of importance to investigate the extent of contamination with copper occurring in milk kept in brass vessels. Milk collected in the dairy was poured into clean brass vessels and was kept for periods of 1 hour and 3 hours respectively.

In each of the above cases, a sample of milk was taken for analysis before processing.

Data regarding the chemical composition and bacteriological quality of different milk samples and the copper content and bacteriological quality of the infant foods are given in Table III.

The curd tension of the reconstituted milk from the infant food as compared with some proprietary infant foods available on the market and also of whole and skim milk powder is given in table IV.

Results and Discussion

The results reported in this paper have shown that it is possible to prepare from buffalo milk an infant food having a low curd tension and good solubility and palatability. It will be observed from the data presented in Table III that, when special precautions are taken to collect and transport milk, the bacterial count of the raw milk as well as that of condensed milk and infant

TABLE III. *Chemical composition and bacteriological quality of different milk samples used for preparation of infant food and the bacteriological quality of infant food produced therefrom*

| Sample | Description of Milk used | Raw milk | | | | | | Dried infant food | |
|--------|---|----------|----------|-----------------------------|----------------------|---------------------------|-------------------|------------------------------------|-------------------|
| | | Fat % | S.N.F. % | Acidity as % of lactic acid | M.B.R. time in hours | Total plate count per ml. | Coliforms per ml. | Total Plate count per g. of powder | Cu content p.p.m. |
| A. | Milk collected in the dairy in sterilized steel vessels | 8.0 | 9.4 | 0.11 | 4.0 | 13,000 | 300 | 8,250 | 4.4 |
| B. | Dairy Milk ... | 7.9 | 9.3 | 0.14 | 2.0—3.0 | 4,500,000 | 28,000 | 35,600 | 4.4 |
| C. | Dairy Milk contaminated by adding straw ... | 7.8 | 9.3 | 0.16 | 0.5 | 18,800,000 | 2,630,000 | 56,750 | 4.4 |
| D. | Dairy Milk kept in Brass vessel for 1 hour ... | 7.8 | 9.2 | 0.17 | 1.0 | 1,200,000 | 38,000 | 42,720 | 8.3 |
| E. | Dairy Milk kept in Brass vessel for 3 hours ... | 7.7 | 9.2 | 0.20 | 1.0 | 1,620,000 | 500,000 | 45,770 | 14.1 |

TABLE IV. *Curd tension of reconstituted milk from some infant foods and of whole and skim milk powder*

| Sl. No. | Description of powder tested | Protein (N × 6.25) % | Fat % | Curd tension |
|---------|--|----------------------|-------|--------------|
| 1. | Infant food (CFTRI) ... | 21.5 | 14.5 | 3.5 |
| 2. | Cow & Gate halfcream* ... | 20.0 | 15.0 | 3.5 |
| 3. | Glaxo* ... | 24.9 | 26.5 | 3.5 |
| 4. | Lactogen* ... | 16.2 | 25.0 | 3.5 |
| 5. | Milk powder† (Spray dried from buffalo milk) ... | 26.5 | 28.0 | 5.5 |
| 6. | Full fat milk powder (Spray dried from cow's milk) ... | 26.2 | 26.2 | 5.2 |
| 7. | Skim milk powder (from buffalo milk) ... | 40.1 | 1.0 | 5.5 |
| 8. | Skim milk powder (from cow's milk) ... | 36.5 | 1.1 | 5.4 |

* Data for fat and protein content taken from Harvey and Hill, *Milk Products*, p. 321. Published by H. K. Lewis & Co. Ltd., London. 2nd Edn. 1948.

† Whole buffalo milk was partially skimmed to a fat content of 4% before spray drying.

food has been found to be very low, comparable to that obtained under better hygienic conditions in U.K. and other Western countries^{15,16}. The data given in table III further show that the bacterial count of the dairy milk was high ranging from 1,200,000 to 4,500,000. When the milk was pasteurised at 185°F, almost all the organisms were killed and the bacterial count of the condensed milk and the infant food prepared from such milk was within the limits of the American standards for the above products⁵.

The results obtained in the present study also clearly indicate that contact of milk with straw affects adversely the colour, flavour, and bacterial quality of milk. Collection and storage of milk in brass vessels for 1 hour and 3 hours increased the copper content of the infant food to 8.3 p.p.m. and 14.1 p.p.m. respectively while infant food prepared from milk collected in aluminium vessels had a copper content of 4.4 p.p.m. As the increase in the copper content of the powder is likely to affect adversely the shelf life of the powder, care should be taken to avoid contamination of the milk with copper during the entire process.

Summary

1. Infant food having a low curd tension, good solubility and palatability and low bacterial count has been prepared from buffalo milk collected in a dairy in Mysore. An infant food having a low bacterial count (35600/per g. of powder) could be prepared from liquid milk having high bacterial count (3-4 millions).

2. When milk is collected in sterilised vessels and transported in a chilled condition, the bacterial count of the raw milk as well as that of condensed milk and infant food has been found to be very low.

3. Collection and storage of milk for 1 and 3 hours in brass vessels has been found to increase the copper content of the infant food to 8.3 p.p.m. and 14.1 p.p.m. respectively while infant

food prepared from milk collected and stored in aluminium vessels had a low copper content (4.4 p.p.m.).

Acknowledgement

The authors are grateful to Shri B. H. Krishna and Shri S. K. Lakshminarayana of the Engineering Division of this Institute for their kind help in carrying out the pilot plant trials. We also acknowledge the help rendered by the Manager, Palace Dairy Farm, Rayanakare, Mysore in the collection of milk required for this work.

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INFANT FOOD FROM BUFFALO MILK

III. Shelf Life of the Product

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The shelf-life of milk powder and infant foods based on milk, depends on the initial quality of the milk and the conditions of manufacture, packaging and storage¹. Two different methods namely (1) roller or drum drying and (2) spray drying, are commonly employed for the preparation of milk powder and infant foods from cow's milk¹. The requirements of an ideal dried infant food are good solubility, low curd tension of the reconstituted milk, good palatability, long shelf life, and high nutritive value. Lea and his co-workers², as a result of extensive studies of the properties of milk powder, reconfirmed the generally recognised fact that spray-dried milk powder is practically completely soluble in cold water. In the case of atmospheric drum-dried powder they found that the solubility in cold water ranged from 70-85 per cent and in warm water at 50°C from 80-95 per cent. Lea, *et al*² reported the results of their comprehensive experimental

study of the effect of moisture content, age and storage temperature on the solubility and palatability of spray dried and roller dried whole milk powder-packed in gas tight cans both in air and nitrogen. They reported that good quality roller dried milk powder possessed a longer shelf-life than spray dried product when both the products were packed in air; but when packed in nitrogen gas, the keeping quality of spray dried milk powder was as good as that of roller dried milk powder. Lea *et al*² further reported that contamination with even small amounts of copper (7 parts per million of milk solids) caused a rapid development of tallowy flavour in milk powder during storage.

No information seems to be available in the literature on the storage properties of milk powder prepared from buffalo milk. The present paper gives an account of the studies on the keeping quality of spray dried infant food prepared

from buffalo's milk. The effect of high bacterial contamination of fluid milk as well as that of contamination of milk with copper, on the keeping quality of infant food have also been studied.

Experimental

The method of preparation and the composition of the different samples of infant food used in these studies have been described in a previous communication³. The five samples of infant food used in the storage studies were prepared in the same manner except for the method of collection of liquid milk which varied from sample to sample. Information regarding the different samples are given below:

Infant food (A) was prepared from buffalo milk collected in clean sterilised stainless steel vessels and transported to the Institute in a chilled condition. The milk had a low bacterial count.

Infant food (B) was prepared from dairy milk which was transported in clean aluminium cans. The time taken for the delivery of the milk at the laboratory was about 3 hours after milking.

Infant food (C) was prepared from dairy milk to which some paddy straw was added to simulate the practice adopted in villages to prevent spilling of milk during transit to nearby towns for sale.

Infant food (D) was prepared from dairy milk which was kept for one hour in brass vessels at room temperature (28°C).

Infant food (E) was prepared from dairy milk which was kept in brass vessels for 3 hours at room temperature (28°C).

The chemical composition of the five samples of food was nearly the same; they contained on the average 14 per cent of fat and 22 per cent of protein.

Packing and storage conditions: The samples, immediately after preparation, were kept in sealed tins in cold storage (4°C) for 2 days before they were packed in smaller cans for storage studies. The powders were packed in seamed unlacquered tin cans (8 oz. size) both in air and in nitrogen. For nitrogen packing, a gas packing cabinet was employed. The method adopted

for packing in nitrogen was similar in principle to that described by Lea *et al*². With the equipment available at the Institute, it was possible to reduce the oxygen content in the nitrogen packed cans only to about 7.5 per cent. The cans were stored at room temperature (25°C–29°C) and at 37°C. Samples were removed at intervals for examination.

Analysis of gases in head space of the stored cans: The gases present in the head space of the cans were analysed for oxygen and carbondioxide by means of Haldane's gas analysis apparatus. For obtaining the gas sample, an equipment similar to that described by Lea *et al*² as modified by the Hannah Dairy Research Institute, Scotland (Private communication from Dr R. Waite) was used. In the modified equipment, the steel puncturing rod is of the screw type and by operating a knob attached to it, it is made to descend and puncture the tin fixed below it by a scaffolding. The gas is collected in an evacuated sampling bulb from which it is transferred to the gas burette of the Haldane apparatus.

Chemical analysis of infant foods: The moisture content of the infant food was determined by drying the powder to constant weight at 100°C in an air oven. The method adopted for the solubility was the same as that described by Howat, *et al*⁴ and it was always corrected for the moisture content of the powder.

Fat acidity was determined by extracting 5 g. of the powder with 50 ml. of a 1:1 mixture of benzene and neutral absolute methyl alcohol containing 0.04% of phenolphthalein and titrating against standard potassium hydroxide solution. The fat acidity has been expressed as mg. of KOH per g. of powder.

The ferric thiocyanate method of Hill and Thiel⁵ was followed for the proxide value and it has been expressed as milliequivalents of oxygen per kg. of the powder.

The vitamin C content was determined according to the colorimetric method of the Association of Vitamin Chemists⁶.

Organoleptic evaluation: A preliminary screening of a large number of the staff members of the Institute was carried out by providing a triangular test with reconstituted milk from fresh and slightly stale powders. Eight of the successful persons

constituted the panel of judges for the entire study. For the assessment of off-flavour present in the stored infant food, a scoring system similar to that used by Lea *et al*² was followed. The different grades were as follows: 0=as good as freshly made powder; 1=a suspicion of off-flavour. 2=slight off-flavour but palatable; 3=marked off-flavour and unpalatable; 4=very marked off-flavour (highly unpalatable).

The infant food having a score higher than 2 was considered unsuitable for infant feeding. The agreement between the judges was fairly good.

Reconstitution of infant food: Thirteen grams of the infant food were reconstituted in 100 ml of distilled water at 45°C. The reconstituted milk was kept at 37°C in a water bath for tasting.

Results

Oxygen absorption: The rate of absorption of oxygen by the different samples packed under air or nitrogen are shown in figures 1 A and 1 B.

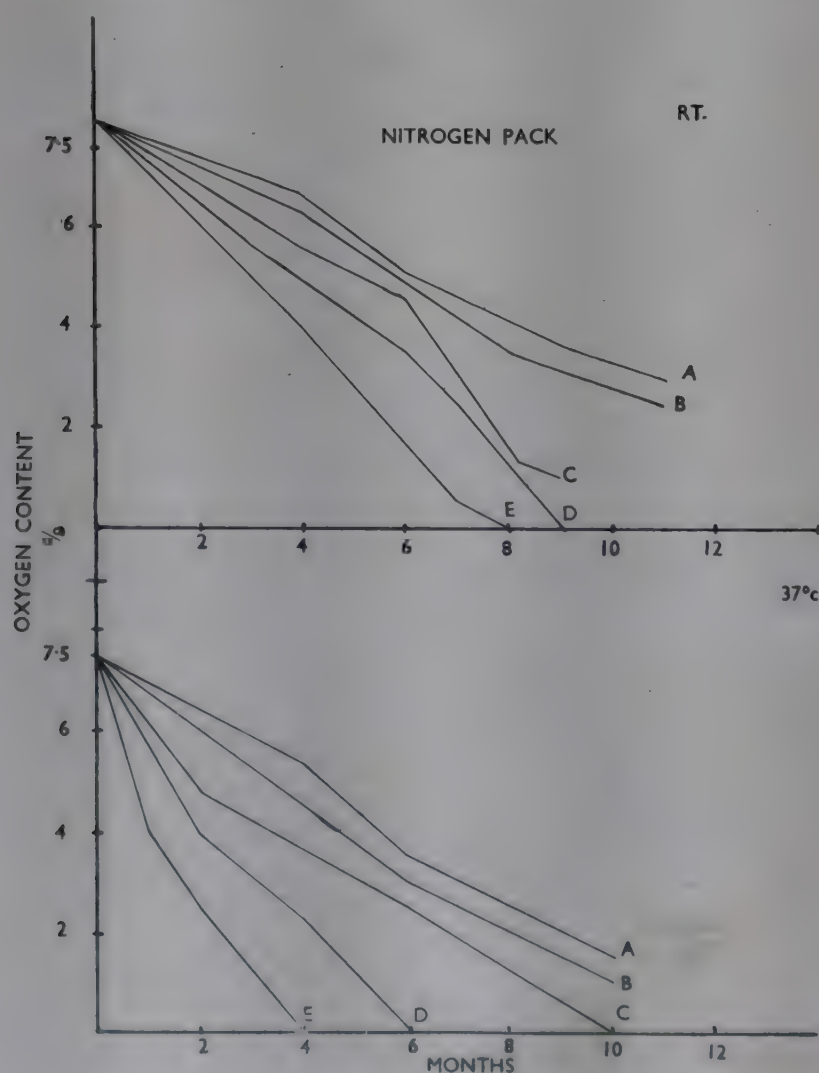


FIG. 1-A

The data have been calculated by assuming an average oxygen content of 20.8 per cent for air and 7.5 per cent for the oxygen content of the head space gas in cans packed in nitrogen. The results show that the infant foods contaminated with copper show the highest absorption of oxygen both at room temperature and at 37°C. There is only a slight difference between the oxygen absorption of the three infant food samples A, B and C prepared from good quality milk, dairy milk and dairy milk contaminated by the addition of paddy straw respectively. As will be seen later, the amount of oxygen absorbed is a fair index of the rate of development of rancidity in the product.

Organoleptic evaluation. The rates of development of off-flavour in different samples are shown in figure 2. It must be mentioned that there is no proportionality between the numerical organoleptic scores and the intensity of off-flavour. For example, in a sample, scored 3 the

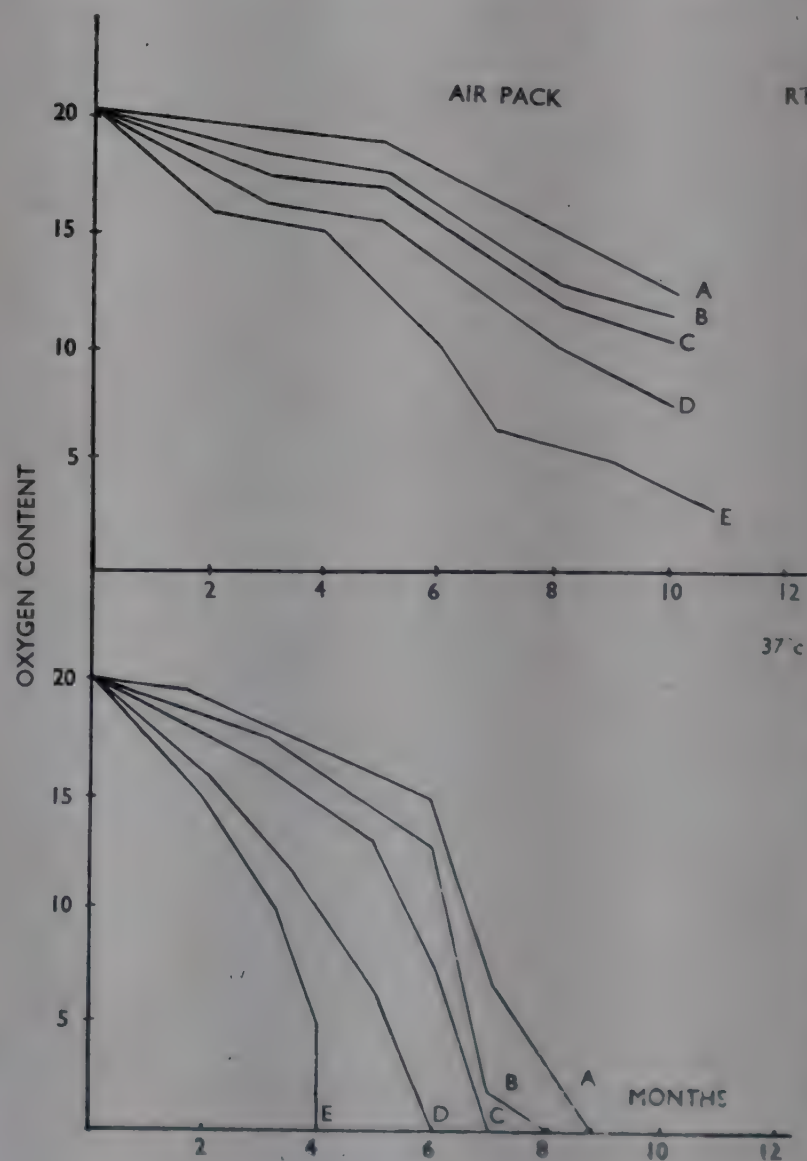


FIG. 1-B

Absorption of oxygen by infant foods during storage.

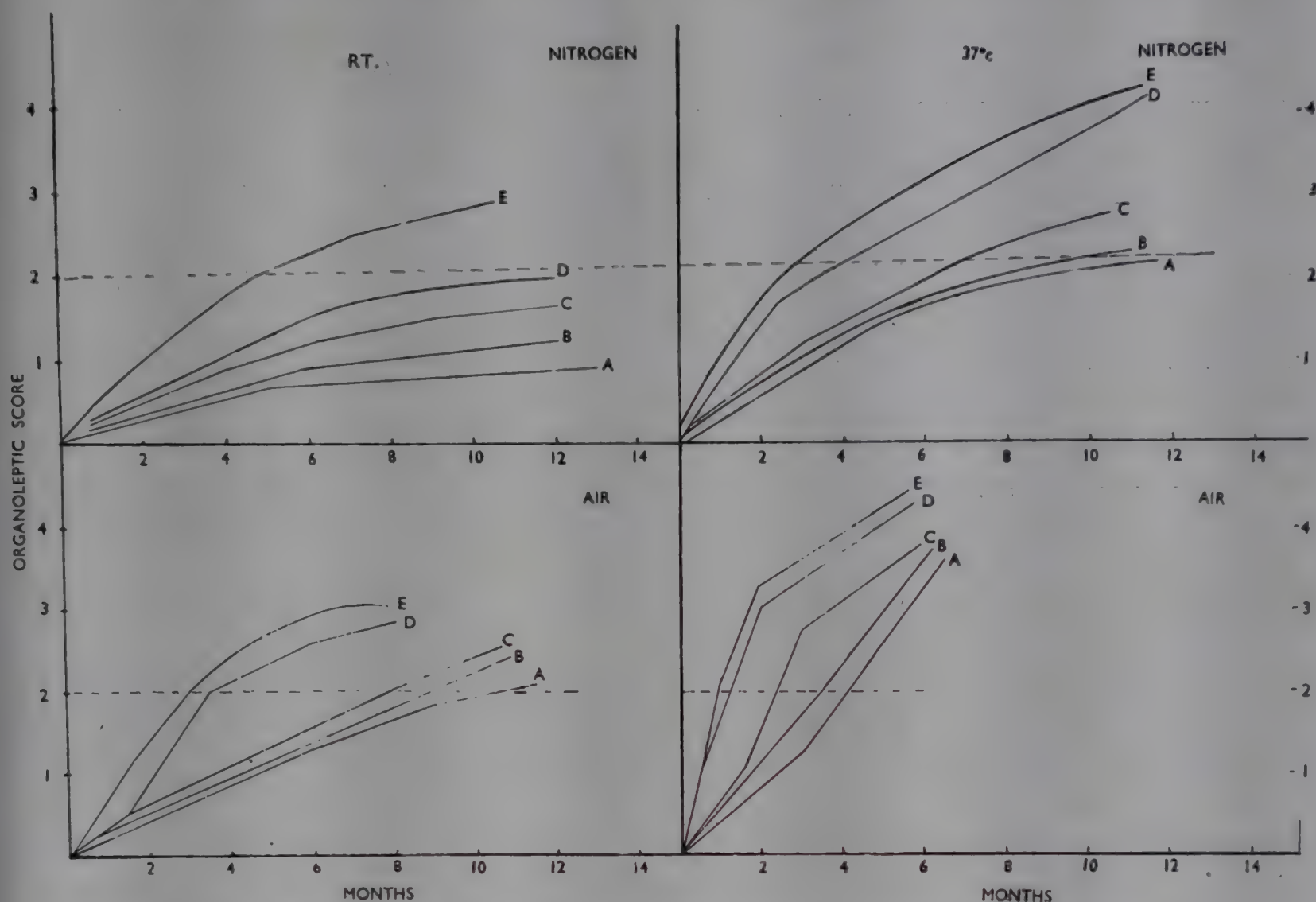


FIG. 2. Organoleptic evaluation of off-flavour developed in infant foods during storage

off-flavour will be many times that of the sample scored 2. The scale used, however, has the advantage that it helps us to fix a score for assessing the degree of off-flavour developed and for deciding on the suitability of the food for infant feeding. The results show that when the food is packed under nitrogen in cans (7.5 per cent O_2 in head space gas), the shelf life is increased to nearly twice that of the air-packed samples. It is also evident that contamination of the product with copper hastens the development of off-flavour and thus affects adversely the shelf life of the product. It is of interest to note that a high initial bacterial count of the liquid milk does not affect the keeping quality of the infant food to any appreciable extent. As stated earlier, the time taken for the infant food to attain a score of 2 (slight rancidity but acceptable) was considered to represent the maximum shelf life of the product. The shelf lives of different samples of the infant food are given in Table I.

TABLE I. Shelf life of different samples of infant foods packed in air and in nitrogen in cans based on organoleptic evaluation

| Sample | Nature of milk used for the preparation of infant food | Room temperature (25°-29°C) | | Stored at 37°C | |
|--------|---|-----------------------------|-------------------|----------------|-------------------|
| | | Air (months) | Nitrogen (months) | Air (months) | Nitrogen (months) |
| A | Powder from Milk collected under sterilized conditions | 11 | 712 | 4.2 | 9.2 |
| B | Powder from Milk collected under ordinary Dairy conditions | 8.7 | 712 | 3.5 | 8.0 |
| C | Powder from Milk contaminated with foreign material like straw | 8.0 | 712 | 2.25 | 6.25 |
| D | Powder from Milk contaminated with copper by storing for 1 hr. in brass vessels | 3.5 | 11 | 1.25 | 3.5 |
| E | Powder from Milk contaminated with copper by storing for 3 hrs in brass vessels | 3.0 | 4.75 | 1.0 | 2.5 |

Peroxide values: The rate of development of peroxide in the fat present in the infant foods is shown in figure 3. In all the cases, an induction period is noticeable after which the increase in the peroxide value is rapid. In the case of samples packed in air, all the samples showed a more rapid development of peroxides than those packed in nitrogen. It is also observed that contamination of the infant food with copper hastens the development of peroxides. When the peroxide values are compared with the organoleptic scores, it is observed, that a peroxide value of 2 corresponds to an organoleptic score of 2, and samples having peroxide value higher than 2 are not organoleptically acceptable. The shelf life of the powders calculated on the basis of time required for attaining a peroxide value of 2 is given in Table II.

It will be seen that the agreement between the shelf lives of the infant food as assessed on the basis of peroxide value and on the basis of organoleptic evaluation is fairly close.

TABLE II. Shelf life of different samples of infant foods based on the peroxide values* (Time taken for developing a peroxide value of 2)

| Sample † | Stored at Room Temperature (25°-29°C) | | Stored at 37°C | |
|----------|---------------------------------------|-------------------|----------------|-------------------|
| | Air (Months) | Nitrogen (Months) | Air (Months) | Nitrogen (Months) |
| A | ... | 12 | 4.7 | 10.0 |
| B | ... | 12 | 4.2 | 7.5 |
| C | ... | 12 | 3.7 | 5.5 |
| D | ... | 8.0 | 2.0 | 3.7 |
| E | ... | 3.75 | 1.75 | 3.0 |

* Food which has developed a peroxide value higher than 2 was found to be unacceptable by organoleptic evaluation.

† For details regarding samples see Table I.

Assuming that the average room temperature was 27° C (range 25°-29°C), the temperature coefficient (between 27°C and 37°C) for the development of off-flavours is approximately 3

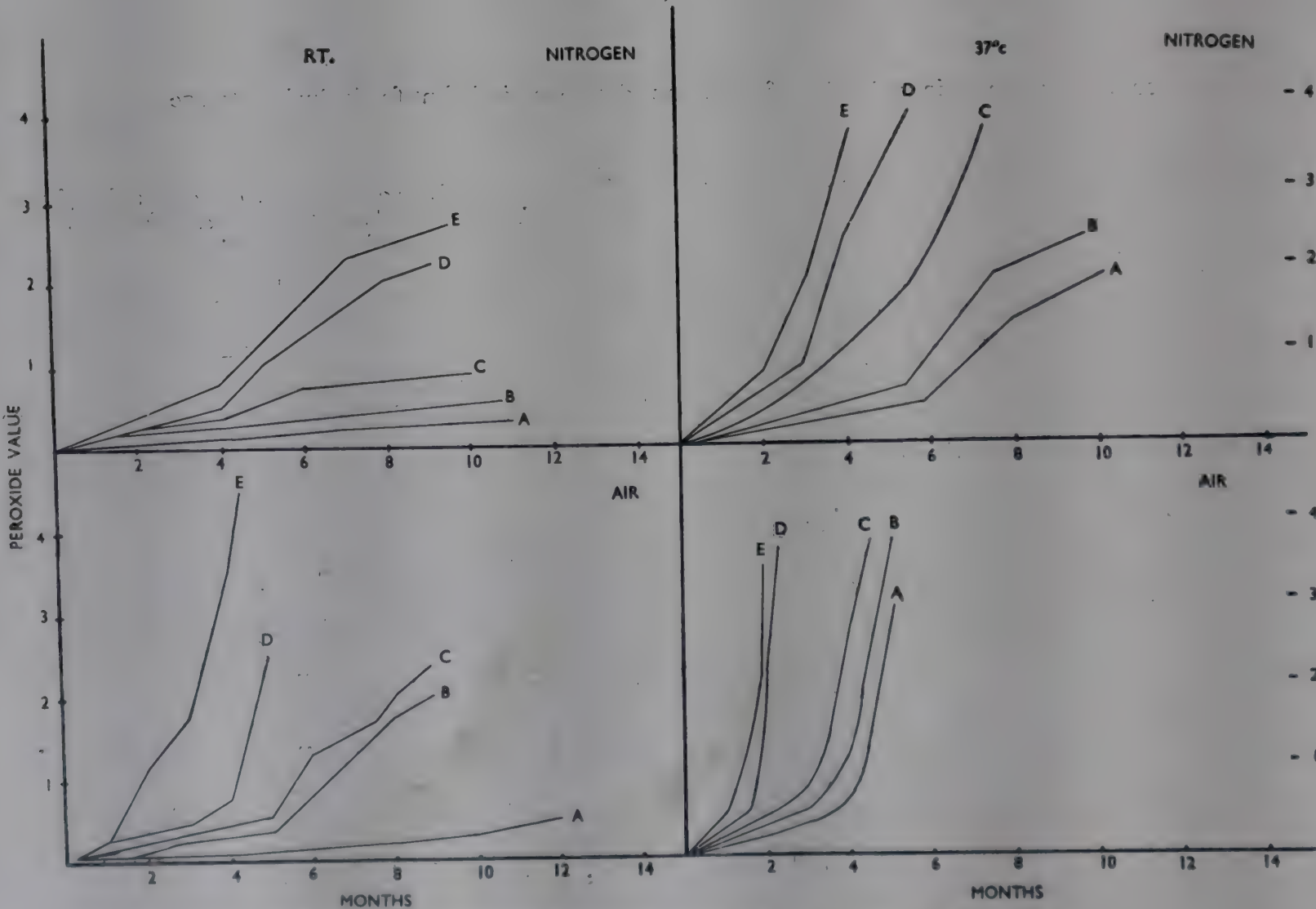


FIG. 3. Development of peroxide values during storage of infant food.

when calculated on organoleptic data and about 2.6 when calculated on peroxide value data. These figures are in fair agreement with a value of 2.6 between 37° and 47°C reported by Lea *et al*².

Solubility of Powder: There was no appreciable change in the solubility of the powder during storage. The solubility of different powders at the end of different storage periods ranged from 98.5-100 per cent.

Fat acidity: In addition to the lipase present in milk, it is likely that the bacteria present in milk may produce lipolytic enzymes. These enzymes may not be completely destroyed during heat processing. The fat acidity in different samples was determined periodically and the results are shown in Table III. The data indicate that a slight increase in the fat acidity had occurred in all the samples.

TABLE III. *Fat acidity of infant food samples † during storage*

(Acidity expressed as mg of KOH per g of infant food)

| Period of storage in months | A | | B | | C | | D | | E | |
|-----------------------------|--------------------|------|--------------|------|--------------|------|--------------|------|--------------|------|
| | Room Temp. 25-29°C | 37°C | R.T. 25-29°C | 37°C | R.T. 25-29°C | 37°C | R.T. 25-29°C | 37°C | R.T. 25-29°C | 37°C |
| 0 (initial) | 0.70 | 0.70 | 1.0 | 1.0 | 1.70 | 1.70 | 0.70 | 0.70 | 0.90 | 0.90 |
| 2 | 0.75 | 0.75 | 1.08 | 1.25 | 1.93 | 1.93 | 0.76 | 0.86 | 0.90 | 1.10 |
| 4 | 0.81 | 0.85 | 1.60 | 1.7 | 2.10 | 2.10 | 0.76 | 0.86 | 1.36 | 1.56 |
| 6 | 1.46 | 1.46 | 1.89 | 2.11 | 2.47 | 2.47 | 0.80 | 0.86 | 1.36 | 1.56 |
| 6 | 1.29 | 1.34 | 1.89 | 2.11 | 2.50 | 2.52 | 0.86 | 0.86 | 1.40 | 1.56 |

† Sample description—See Table I

Stability of vitamin C: The vitamin C content of different samples was determined periodically. The results are given in table IV. The data indicate that about 50 per cent of the initial vitamin C (activity) was destroyed during storage of infant food prepared from dairy milk. The rate of destruction was higher in samples contaminated with copper. The retention of vitamin C was slightly higher in samples packed in nitrogen as compared with those packed in air.

Summary

1. The keeping quality of infant food prepared from buffalo milk using Niro spray drier and

TABLE IV. *Loss of vitamin C (ascorbic acid) in Infant food during storage*

| Description of infant food (Vide Table I) | Initial content of vitamin C mg/100g | Vitamin C content of infant food stored for 6 months | | | |
|---|--------------------------------------|--|------|----------|------|
| | | At Room temperature | | At 37°C | |
| | | Nitrogen | Air | Nitrogen | Air |
| A | 17.0 | 13.3 | 12.7 | 13.0 | 10.2 |
| B | 16.5 | 13.3 | 10.2 | 11.4 | 9.8 |
| C | 15.8 | 12.6 | 11.0 | 10.7 | 6.0 |
| D | 14.2 | 8.0 | 6.2 | 7.1 | 5.0 |
| E | 14.0 | 6.0 | 5.0 | 5.1 | 3.0 |

packed in air and in nitrogen has been studied. The food prepared from milk collected in aluminium vessels under average prevailing conditions in the dairy, and packed in 8 oz. cans under nitrogen (7.5 per cent O₂ in head space gas) had a shelf-life of 8 months at 37° C and about 16 months at 27° C.

2. An infant food having a low bacterial count (4 thousand) and satisfactory shelf life could be prepared from dairy milk having a high bacterial count (4-5 millions).

3. Contamination of fluid milk with copper caused by keeping the milk in brass vessels, affects adversely the shelf life of the infant food.

4. Fair agreement was observed between the development of off-flavour assessed organoleptically and the peroxide value of the fat in the powder.

Acknowledgement

We are thankful to Dr R. Waite of the Hannah Dairy Research Institute, Scotland, for giving us valuable suggestions in planning the experiments during his visit to this Institute as an F.A.O. expert.

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INFANT FOOD FROM BUFFALO MILK

IV. Large Scale Production of Infant Food

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(Central Food Technological Research Institute, Mysore)

India is now importing about 3,000 tons of infant foods, based mainly on milk. This is apart from other milk foods, containing malt extract, cocoa and such other additions. In an earlier publication¹, the possibility of developing the manufacture of infant food and other milk products in India has been indicated. While much has still to be done regarding the dairy development in India, it is possible even now to establish milk processing industry and infant food industry in certain regions of the country like Saurashtra, E. Punjab, Uttar Pradesh and Baroda where sufficient buffalo milk is available. The approximate quantity of milk required for the production of the infant foods at present imported into India is estimated to be approximately 30 thousand tons of fluid milk. This quantity can be easily collected from Saurashtra, Punjab and Uttar Pradesh without appreciably affecting the fluid milk consumption of these areas. The success of Kaira District Co-operative Milk Producers' Union at Anand in organising the collection and processing of milk on large scale is an outstanding instance of how cooperation and organisation can help in the dairy development in our country. During flush season from October to February, the Union is able to collect daily about 300,000 lb. of milk apart from what it sends to Bombay Milk Scheme. This milk is now being processed in its modern plant into products like whole milk powder, skim milk powder, casein, butter and ghee. This Union is organised in such a way that the supply of milk is being rapidly stepped up. The success of the Kaira Co-operative Milk Union indicates that it is possible to establish similar units in several other regions like Patiala in Punjab, Hathras in Uttar Pradesh, Mehsana in Gujrat and in other localities where there is a large surplus of milk.

Standardization of Production of Infant Food from Buffalo milk

All the above surplus areas produce mainly buffalo milk. Production of infant food from cow's milk is a well established industry in many countries. In view of the fact that at present

only buffalo milk is available for this purpose, investigations were undertaken at the Central Food Technological Research Institute, Mysore to standardize the conditions for the production of infant food from buffalo milk². The important steps in the production are: (i) reduction of fat content of the buffalo milk to 2.5 per cent (ii) addition of phosphate buffer salts to react with ionised calcium and thus reduce the curd tension of the infant food (iii) addition of sugar so as to reduce the protein content of the final product to about 22 per cent and the fat content to about 14 per cent (iv) concentration (v) addition of vitamins and homogenization (vi) drying and (vii) packing in nitrogen atmosphere.

The composition of the infant food standardized at the Central Food Technological Research Institute and prepared at Anand is given in Table II.

It may be observed that the fat content of the product has been intentionally kept at 14 per cent to facilitate easy digestion of the product by the infants. Studies on the keeping quality of the product³ have shown that the most important factors which affect it adversely are: (1) contamination of the milk with copper, caused by keeping the milk in brass vessels, (This could easily raise the copper in the powder to as high a level as 14 p.p.m., and reduce the shelf life to about 2 months), (2) high initial bacterial load of the milk and (3) oxygen content of the atmosphere in which the powder is packed. Nitrogen packing with initial oxygen content less than 7 per cent was adequate in keeping the powder in an acceptable condition for one year at 37°C.

Feeding trials carried out at Mysore, with the infant food on 10 infants aged 4-9 months for periods ranging from 2 to 9 months, showed that the infants readily digested the food and grew normally.

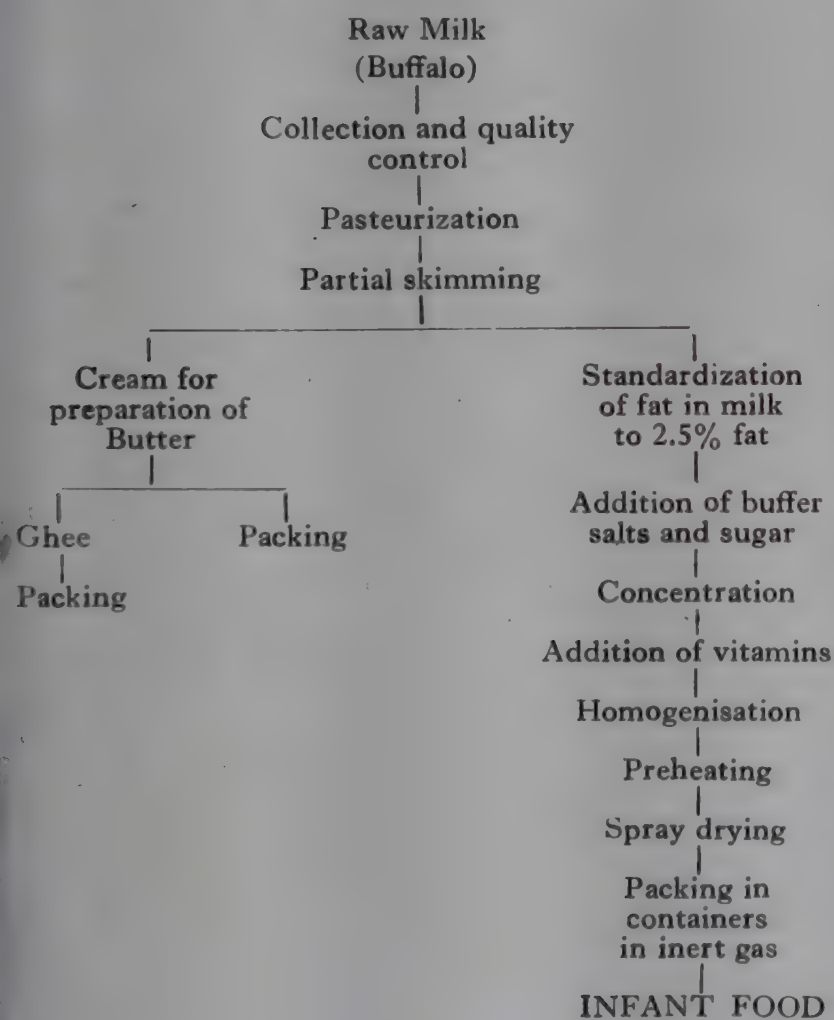
Large scale production of the Infant Food at the Dairy of Kaira District Co-operative Milk Producers' Union

The Kaira District Co-operative Milk Producers' Union at Anand has recently built a modern milk processing factory and installed a

pray drier with a production capacity of 5 tons of powder per day. International organisations like the UNICEF, and the F.A.O., Governments of the Indian Union, Bombay State and New Zealand have collaborated in the project. Among the different products being made in this factory are whole milk powder, skim milk powder, casein, butter and ghee. With the active co-operation of the authorities of the Union, it was possible for us to run a large scale trial of the preparation of infant food with the equipment available with them. The National Research Development Corporation of India (Government of India) provided the necessary funds for this trial. A short account of the experimental production is given below and a flow diagram is shown in figure I.

FIG. I

FLOW SHEET FOR THE MANUFACTURE OF INFANT FOOD



Collection of Milk: The quality of fluid milk is particularly important in obtaining an infant food with low bacterial count and good keeping quality. To ensure suitable supplies of raw milk of the right quality, only a restricted area

comprising 11 collecting centres was selected and the milk was collected under strict supervision. The brass vessels normally used in this region were tinned in order to avoid contamination of milk with copper. The milking vessels were daily cleaned and washed with boiling water. The milk was transported to the Central Dairy by lorries within 2 hours of milking. Immediately on arrival, the milk was examined for its fat content, S.N.F. (by lactometer), M.B.R. time, and standard plate count (Table I).

TABLE I. *Some quality characteristics of fresh buffalo milk*

| Item | Maximum | Minimum | Average |
|----------------------------------|------------------|-------------------|-------------------|
| Fat % | 9.2 | 7.0 | 8.0 |
| S.N.F. % | 10.3 | 9.0 | 9.6 |
| M.B.R. time (hours and min.) | 4-0 | 0-45 | 2-54 |
| Standard plate count per c.c.... | 17×10^6 | 1.5×10^6 | 5.2×10^6 |

Fat adjustment and pasteurisation

The average fat content of the milk received was 8.0 per cent. For the preparation of infant food the fat had to be adjusted to 2.5 per cent. This was done by passing the pasteurised milk through the cream separators, adjusted to give a fat content of 2 per cent in the separated milk. The final fat content of the batch was adjusted by adding pasteurized cream. The pasteurization temperature was maintained at 185°F with an idea of developing the sulphydryl groups in the milk at this stage⁴. This helped in avoiding preheating before concentration, a step which involved some technical difficulties.

Adjustment of composition

Two batch trials with 7940 lb. and 17,500 lb. of milk respectively, were made (Fat—2.5 per cent S.N.F.—9.4 per cent). To the milk in the holding tank, a calculated quantity of buffer salts in solution was added. Cane sugar was then added in the proportion of one part of cane sugar to 2.5 parts of total milk solids (Cane sugar was dissolved in water and the syrup boiled for five minutes to avoid contamination of the pasteurised milk with any micro-organism present in cane sugar).

Concentration, addition of vitamins, homogenization and drying

After standardisation of its composition, the milk was pumped into the evaporator. This is a Wiegand type double effect, high speed circulating evaporator, working under a vacuum of 26". Its capacity is about 1300 lb. of condensed milk (45 per cent solids) per hour. The concentrated milk (18° Be) was drawn off into a square aluminium tank and the required quantities of vitamins calculated on total solids, were added (The water soluble vitamins and a water miscible preparation of vitamin A (Roche) were dissolved in water and vitamin D and E in a small amount of cream). The concentrated milk was homogenised under a pressure of 1000 lb. per sq. in. and then pumped into a vertical stainless steel tank. It was then pre-heated to 140° F and fed into the spray drier (Niro). The temperature of the inlet air into the spray drier was 350° F and that of the outlet air maintained at 215° F. The powder was collected in 25 lb. tins.

Packing

The infant food was transferred to tins of 1 lb. capacity or less and packed in nitrogen according to the procedure described by us earlier³.

Composition of the Infant Food

Table II shows the composition of the product.

The solubility of the infant food determined according to methods outlined by Howat *et al*⁵ was 99.5 per cent.

A loss of about 50 per cent of vitamin C added was anticipated from the results of earlier experiments. The standard plate count of the powder was 20,000 per g. This is much lower than the American standard of 48,000 per g. for premium grade whole milk powder⁶.

TABLE II. *Approximate composition of the infant food prepared at Kaira District Co-operative Milk Producers' Union, Anand*

| Constituents | | % | Vitamins added per 100 g. powder | |
|--|-----|------|----------------------------------|------|
| Water | ... | 3.0 | Vitamin A (I.U.) | 1500 |
| Protein | ... | 22.0 | „ D (I.U.) | 40 |
| Carbohydrates (Lactose and Cane Sugar) | ... | 56.0 | „ B ₁ (mg) | 1 |
| Fat | ... | 14.0 | „ B ₂ (mg) | 1 |
| Ash | ... | 5.0 | Niacinamide (mg) | 6 |
| Calcium | ... | 1.0 | Pyridoxine (mg) | 0.6 |
| Phosphorus | ... | 1.0 | Vitamin B ₁₂ (μg) | 2 |
| | | | „ C (mg) | 30 |

Work in Progress

The product prepared at Anand has been distributed to several centres for feeding trials on infants. The results obtained in feeding trials in progress at Mysore and some other centres indicate that the food is readily digested by infants and they thrive well on the food. Investigations on the shelf-life and vitamin content of the product stored at different temperatures are in progress.

Acknowledgement

We are very grateful to the Kaira District Co-operative Milk Producers' Union Ltd., Anand, for all the help rendered in the manufacture and testing of the infant food.

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INFANT FOOD FROM BUFFALO MILK

V. Infant Feeding Trials

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In previous communications from this laboratory¹⁻⁴, investigations relating to the preparation and shelf life of infant food from buffalo milk were reported. The results obtained in the above investigations showed that an infant food having a low bacterial count and curd tension and satisfactory shelf life could be prepared from buffalo milk. In view of the fact that milk foods prepared from buffalo milk are not being used so far to any appreciable extent for infant feeding², it was considered desirable to carry out feeding trials on infants under controlled conditions with a view to obtain data regarding the value of the product for infant feeding. The results are reported in this paper.

Experimental

Material: The infant food used in these trials was the same as that described in an earlier paper⁴. Data regarding the composition of the product have already been reported.

Feeding of infants: The infants included in the feeding trials belonged to the middle and lower middle classes. They were clinically examined and only those in good health and free from ailments were included in the study. The infants were weighed on the first day of the experiment. Their age was recorded to the nearest week. The period of feeding varied from one to five months. The infants were weighed once a fortnight. Records regarding the digestibility of the infant food and the clinical condition of the infants were maintained during the experimental period. The investigations were carried out in the following centres: (1) Central Food Technological Research Institute, Mysore, (2) Kalavati Saran Children's Hospital, New Delhi, and (3) 'Bala Mandir', Madras. The results obtained in Kalavati Children's Hospital, New Delhi, and 'Bala Mandir', Madras are presented in Tables I and II. The results of investigations carried out in Mysore are shown in fig. I. A comparative summary of results are given in Table III.

TABLE I. *Infant feeding trial at Kalavati Saran Children's Hospital, New Delhi*

| Sl. No. | Age at start (months) | Duration of feeding (months) | Weight at the beginning of expts. (lb) | Weight at end of period (lb) | Increase in wt. (lb) | Increase in wt. per month (lb) |
|---------|-----------------------|------------------------------|--|------------------------------|----------------------|--------------------------------|
| 1 | 2 | 1 | 7.06 | 9.75 | 2.69 | 2.69 |
| 2 | 2 | 2 | 8.06 | 10.56 | 2.50 | 1.25 |
| 3 | 1 | 2 | 5.87 | 8.37 | 2.50 | 1.25 |
| 4 | 1 | 2 | 5.37 | 8.37 | 3.00 | 1.50 |
| 5 | 1.5 | 2 | 7.87 | 9.06 | 1.19 | 0.59 |
| 6 | 0.9 | 1.5 | 7.43 | 11.18 | 3.75 | 2.50 |
| 7 | 2.5 | 1.5 | 7.93 | 11.43 | 3.50 | 2.33 |
| 8 | 2.5 | 1.0 | 10.75 | 12.12 | 1.37 | 1.37 |
| 9 | 1.0 | 1.0 | 7.12 | 8.15 | 1.03 | 1.03 |
| 10 | 1.7 | 1.0 | 7.18 | 8.06 | 0.88 | 0.88 |

TABLE II. *Infant feeding trial at Bala Mandir, * Madras*

| Sl. No. | Sex | Age at start (months) | Duration of feeding (months) | Weight at the beginning of experiments (lb) | Weight at end of period (lb) | Increase in wt. (lb) | Increase in wt. per month (lb) |
|---------|-----|-----------------------|------------------------------|---|------------------------------|----------------------|--------------------------------|
| 1. | F | 2 | 2.4 | 8.25 | 9.06 | 0.81 | 0.34 |
| 2. | M | 5 | 2.4 | 9.0 | 9.5 | 0.5 | 0.20 |
| 3. | M | 3 | 2.4 | 8.5 | 8.81 | 0.31 | 0.13 |
| 4. | F | 1 | 2.4 | 7.5 | 9.37 | 1.87 | 0.8 |
| 5. | F | 9 | 2.4 | 10.81 | 11.31 | 0.50 | 0.20 |
| 6. | M | 1.5 | 2.2 | 11.56 | 13.06 | 1.50 | 0.70 |
| 7. | F | 7.0 | 2.2 | 9.31 | 10.43 | 1.12 | 0.5 |

* The infants in this orphanage were all very much underweight.

TABLE III. *Comparative data showing the increase in weight of infants under experiments at different centres*

| Name of Centre | No. of infants | Age of infants (Range) | Duration of feeding (Range) months | Increase in weight per month | | |
|----------------|----------------|------------------------|------------------------------------|------------------------------|--------------|--------------|
| | | | | Maximum (lb) | Minimum (lb) | Average (lb) |
| Mysore... | 52 | 9 days-11.5 mts. | 1-5 mts. | 1.86 | 0.27 | 0.83 |
| Delhi ... | 10 | 27 „ - 2½ mts. | 1-2 „ | 2.69 | 0.59 | 1.60 |
| Madras... | 7 | 1 month to 7 months | 2.4 „ | 0.8 | 0.13 | 0.41 |

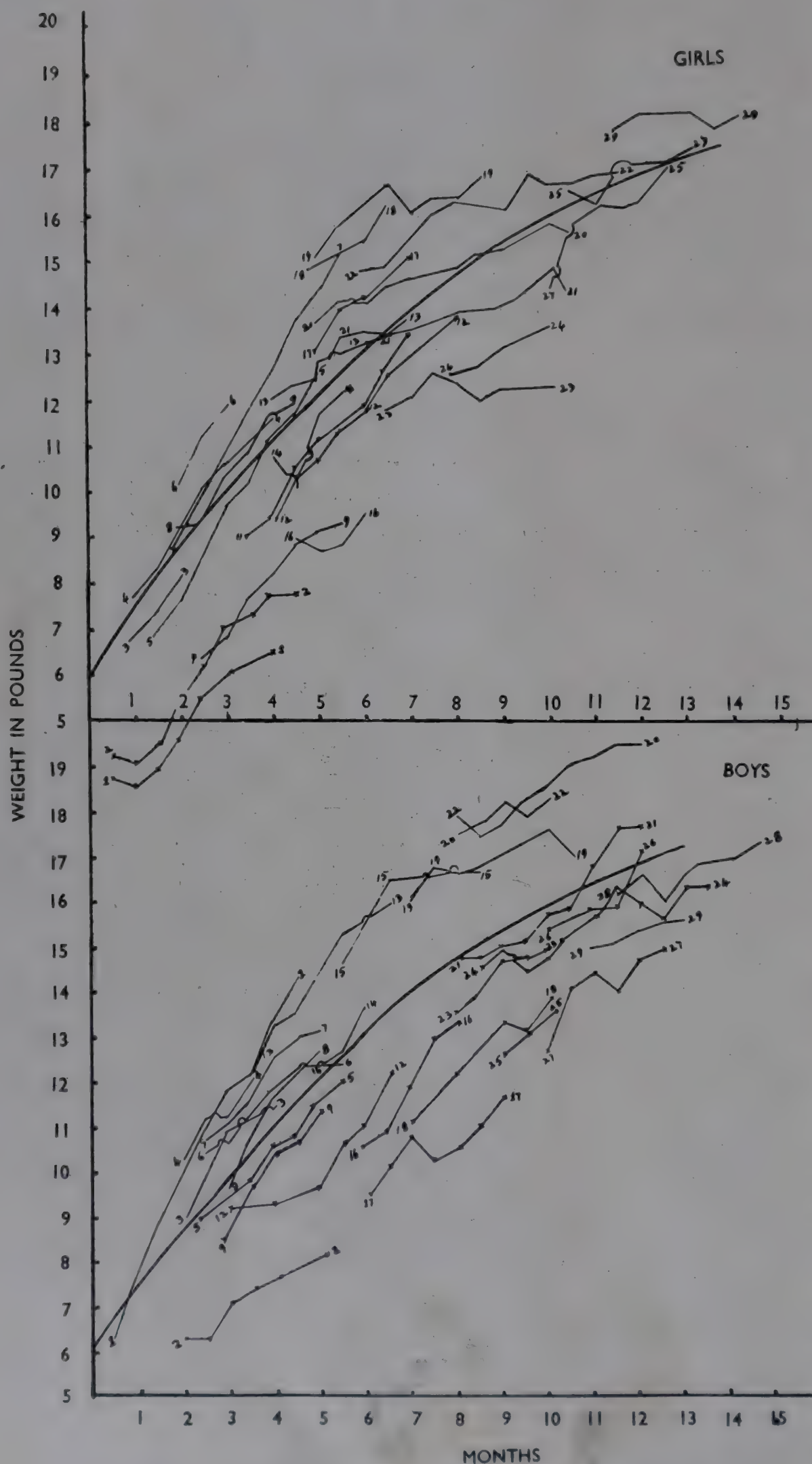


FIG. 1. Growth of infants on Infant feeding trials in Mysore

Results and Discussion

Clinical data obtained from the different centres showed that all the infants under experiment digested the food readily. The infants also consumed the reconstituted milk with great relish and there were no cases of vomiting after the intake of the food.

The results presented in Table III show that the average rate of growth per month of infants in the three different centres ranged from 0.41 to 1.60 lb. In general infants whose weights were much below normal at the start of the experiment grew at a lower rate than those whose body weights were nearer normal. The rate of growth of infants during the first year has been reported to be related to the birth weight⁵. Data regarding the birth weight were available only for the infants under experiment in Mysore.

It was not possible to include a control group of infants fed on cow's milk or a well known preparation of infant food. Hence for obtaining a standard growth curve for comparing the growth rate of infants fed on the infant food, the following procedure was adopted. The infants with birth weights ranging between 5 to 7 lb. were grouped according to age. The average body weights of the infants at the beginning of the experiment were plotted against

the age. The curve thus obtained was taken as the standard growth curve for the infants under experiment in Mysore. As there was no difference between the growth curves of the male and female infants, a combined standard curve for infants of both the sexes is given in Fig. I. The standard curve shown in Fig. I was drawn by fitting a smooth curve to the various points arrived at by plotting the average weight of the infants against their age.

The growth rates of individual infants fed on the infant food in Mysore shown graphically in Fig. I show that the growth rates for about 12 male infants and 13 female infants are greater than the standard curve. The growth rates of 15 male infants and 13 female infants are less than the standard curve and it is of interest to note that in all these infants, a spurt in the growth rate is noticeable during the period of feeding of the infant food. The results clearly indicate that the infant food has promoted a higher rate of growth than that observed in the same infants before the start of the experiment. The rate of growth of infants observed in the present experiment compare favourably with the average growth rate reported for Indian infants⁶. The present investigation though carried out on comparatively small number of infants, has, nevertheless clearly demonstrated that the infant food prepared from buffalo milk is readily digestible and promotes good growth in infants.

Summary

1. Feeding experiments with an infant food prepared from buffalo milk were conducted in three centres under strict medical supervision on about 75 infants. The infant food contained

22 per cent protein and 14 per cent fat and was fortified adequately with vitamins A and D. Records regarding the growth and general health of the infants and the digestibility of the food were maintained.

2. The results showed that all the infants digested the food readily. The infants consumed the reconstituted milk with great relish and there were no cases of vomiting after the ingestion of the milk. The average rate of growth of the infants was quite satisfactory comparing well with the average rate of growth of Indian infants available in the literature.

Acknowledgement

Our thanks are due to Dr J. S. Krishnamurthy and Dr M. Narayana Rao of Mysore, who helped us in obtaining some of the subjects, to Drs S. Manjubhashini and G. Laxmibai of Bala Mandir, Madras and Dr (Mrs) Sheila Singh Paul of Kalavati Saran Children's Hospital, New Delhi, for kindly carrying out the feeding trials in their centres.

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EFFECT OF VANILLIN ON STABILITY OF VEGETABLE SHORTENING

K. M. NARAYANAN, N. S. KAPUR, G. S. BAINS AND D. S. BHATIA

(Central Food Technological Research Institute, Mysore)

Vanillin is used extensively as a flavouring agent in bakery and confectionery products. Being a phenolic aldehyde, it may afford protection to such products against oxidative rancidity. Bickoff¹ and Mitra² reported the antioxidant properties of vanillin for preserving carotene and rosin, respectively. However, no study seems to have been made regarding the effect of this flavouring agent on the stability of fats and processed fatty foods. The present investigation deals with the effect of vanillin on the stability of partially-hydrogenated shortening (m.p. 37°C) based on groundnut oil.

Materials and Methods

The vanillin used was of B. P. grade (m.p. 80.5°C). Its purity was also confirmed according to the spectrophotometric procedure of Sharp³. Homogenous dispersions of vanillin in the test shortening were prepared by mixing thoroughly its solution in chloroform, with the fat. An equal volume of chloroform was also added to the control. Stability tests were carried out by storing at 100°C \pm 2°C, weighed aliquots of the treated shortening containing 0.1, 0.2, 0.3, 0.4, 0.5 and 0.6% of vanillin respectively, in 100 ml. Pyrex glass beakers, for a period of 10 days. The development of rancidity in the samples was followed periodically by determin-

ing the peroxides, free fatty acids, Kreis test and by organoleptic evaluation.

Kreis test was carried out in accordance with the modification suggested by Pyke⁴ and the colour was measured in the Lumetron photoelectric colorimeter (530 m μ filter) after appropriate dilution and also in the B. D.H. Lovibond Tintometer by using 1-cm. cell. The peroxide values expressed as millimoles/kg. fat, were determined according to Lea's method^{5, 6} and the free-fatty acids (as oleic acid) by the A. O. C. S. method⁷.

Results and Discussion

Effect of vanillin on the development of peroxides in the shortening: The initial peroxide values for the vanillin containing samples (Fig. 1) are approximately of the same order as of the control, indicating that vanillin does not interfere in the determination of peroxide value. This point was verified further by taking a fat of known peroxide

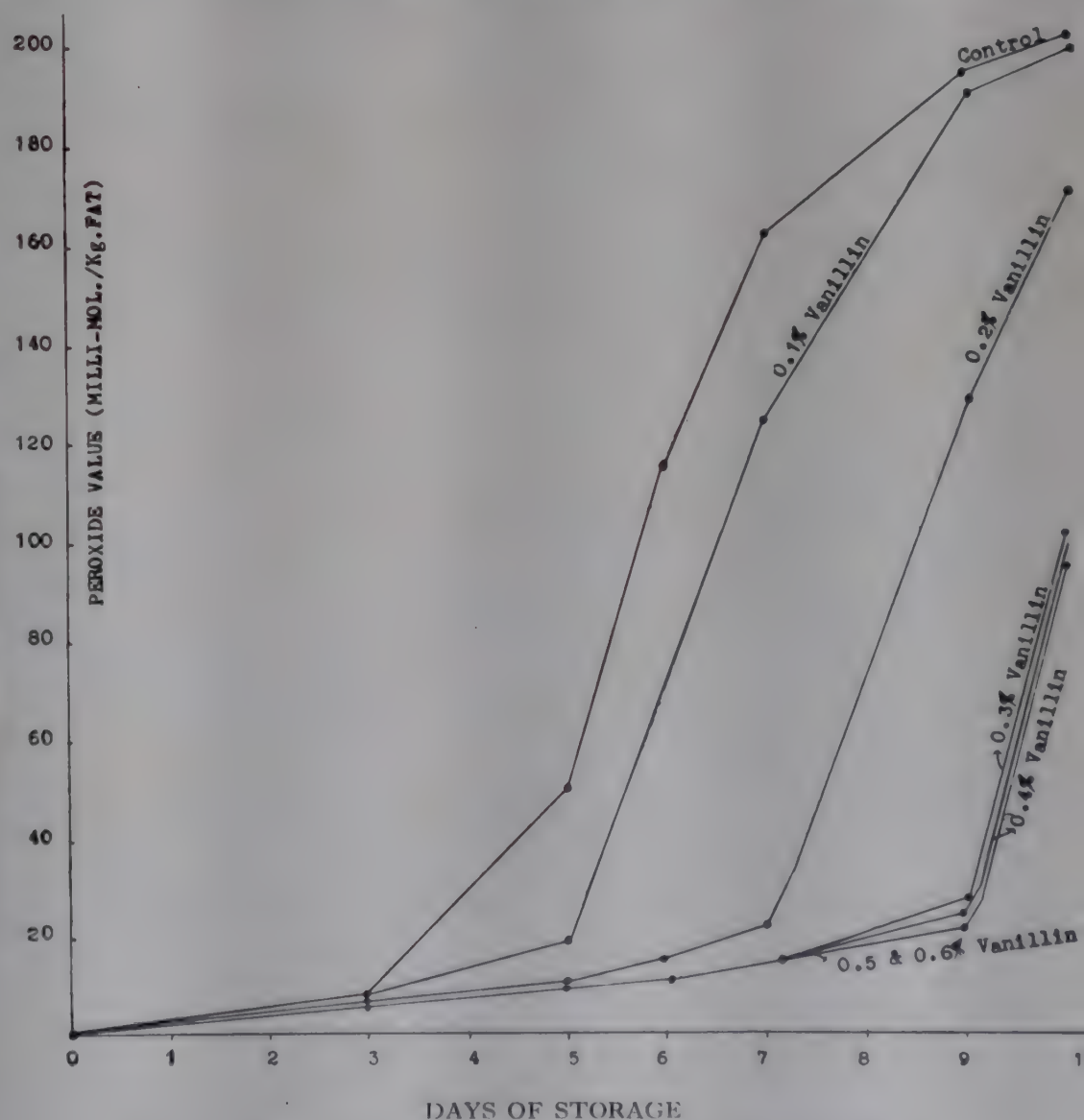


FIG. 1. Effect of vanillin on the development of peroxides during storage of shortening.

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value and by carrying out the estimation after incorporating vanillin.

As compared with the 3-day induction period of the control sample, the shortening containing 0.3% vanillin, showed an induction period of nine days. Further increase in the vanillin content of the shortening (0.4-0.6%) did not however, extend the induction period, beyond nine days.

Effect of vanillin on the Kreis test of the shortening:

In a preliminary study involving the reaction of phloroglucinol with vanillin, the formation of a reddish-orange complex was observed. The initial optical density determinations by the Lumetron Photoelectric colorimeter tend to show higher Kreis Test values for the vanillin containing samples. However, as storage progressed, the control sample developed Kreis test much faster than the samples containing vanillin. Upto 0.3% vanillin in the fat (Fig. 2) the anti-oxidant effect of vanillin is evident but further increase in the vanillin content (0.4-0.6%) had no additive effect. The Kreis Test colour values measured in the Lovibond Tintometer (Table I) reveal that the phloroglucinol—vanillin complex is a blend

of yellow and red units. Initially, both the red and yellow units increased as the vanillin content of the fat increased but the increase in yellow units is quite marked. Finally, as storage advanced, red units increased and after 96 hrs. of storage, red colour predominated. The intensity of the Kreis test colour was relatively less in vanillin containing samples than that of the control.

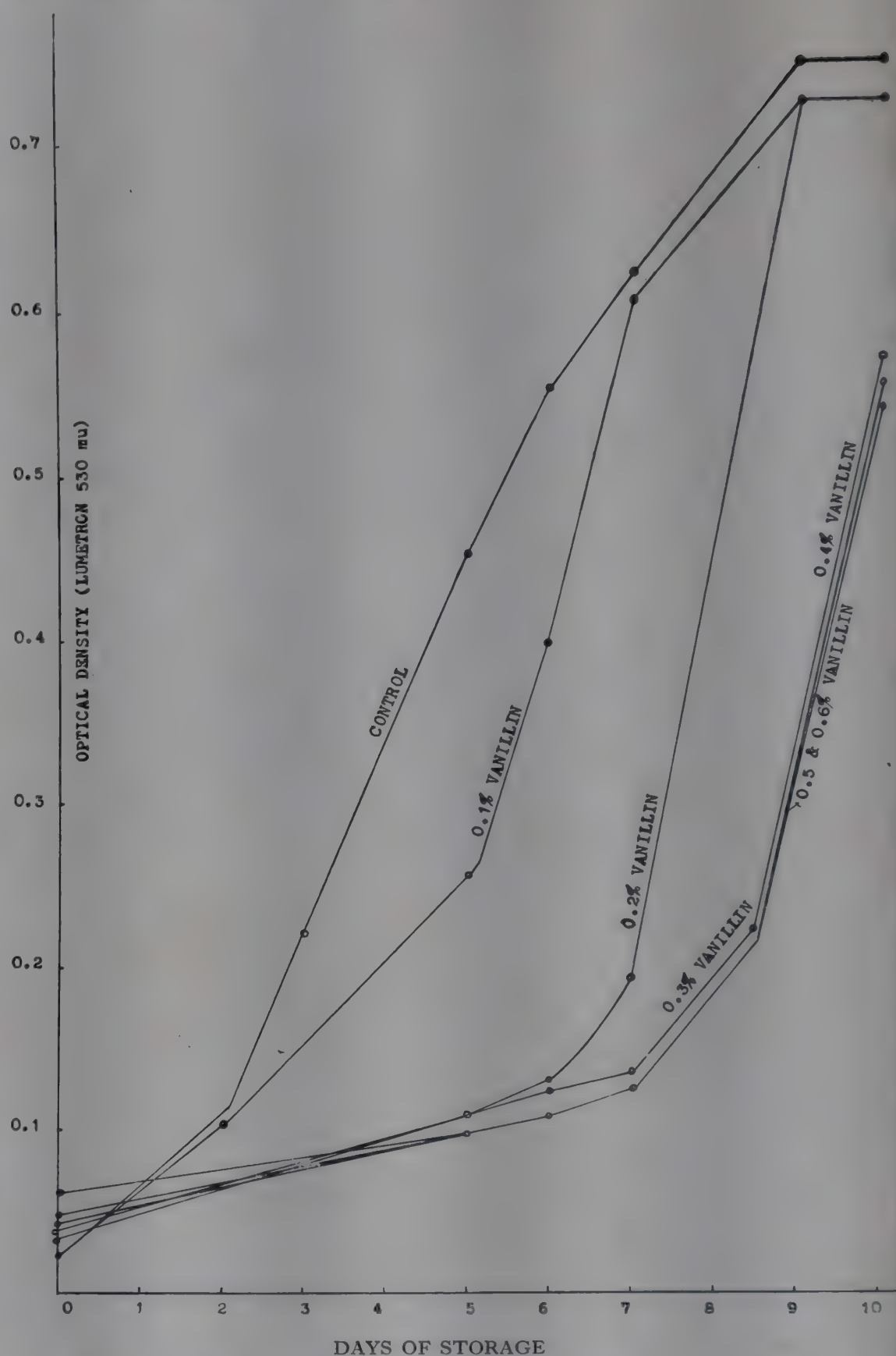


FIG. 2. Effect of vanillin on the development of Kreis test values during storage of shortening.

Effect of vanillin on the development of free-fatty acids in the shortening: Shortenings containing vanillin showed higher titratable acidity than that of the control (Table II). This may be explained by the fact, that vanillin possesses phenolic and aldehydic groups and is known to titrate with an alkali solution. However, free-fatty acids determined at the expiry of 240 hrs. of storage showed a decrease in samples con-

TABLE I. *Effect of Vanillin treated shortenings on Kreis test* values determined by B.D.H. Lovibond Tintometer*

| Storage time (hrs.) | Percentage of vanillin in the shortening | | | | | | |
|---------------------|--|-------------|-------------|-------------|-------------|-------------|-------------|
| | 0.0 (Control) | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| 0 | 1.4 R O Y | 2.0 R 0.5 Y | 2.2 R 0.8 Y | 2.2 R 1.0 Y | 2.4 R 2.0 Y | 3.1 R 3.0 Y | 3.1 R 4.6 Y |
| 17 | 4.0 R O Y | 3.0 R 0.1 Y | 3.0 R 0.6 Y | 3.2 R 1.0 Y | 3.5 R 2.0 Y | 3.8 R 3.0 Y | 4.0 R 4.6 Y |
| 48 | 5.2 R O Y | 5.3 R 0.1 Y | 5.1 R 0.6 Y | 5.4 R 1.0 Y | 5.2 R 1.0 Y | 5.3 R 1.0 Y | 5.3 R 2.0 Y |
| 96 | 8.1 R | 8.2 R | 7.6 R | 7.5 R | 7.7 R | 7.2 R | 7.2 R 0.4 Y |
| 120 | 18.0 R | 10.6 R | 8.0 R | 7.8 R | 8.3 R | 8.2 R | 8.1 R |

* 0.5 g. fat + 5 ml. of 1 % phloroglucinol in acetone + 0.05 ml. of concentrated sulphuric acid.
R and Y designate red and yellow units respectively.

TABLE II. *Effect of Vanillin on the development of free-fatty acids in the shortening*

| Storage time (hrs.) | Percentage of vanillin in the shortening | | | | | | |
|---------------------|--|------|------|------|------|------|------|
| | 0.0 (Control) | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| 0 | 0.13 | 0.28 | 0.41 | 0.56 | 0.69 | 0.85 | 0.98 |
| 240 | 2.77 | 1.69 | 0.87 | 0.41 | 0.36 | 0.41 | 0.41 |

TABLE III. *Effect of Vanillin on organoleptic quality of shortening*

| Storage time (hrs.) | Percentage of vanillin in the shortening | | | | | | |
|---------------------|--|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | 0.0 (Control) | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| 0 | Good | Good | Good | Good | Good | Good | Good |
| 72 | " | " | " | " | " | " | " |
| 120 | Rancid | Slight off-flavour | " | " | " | " | " |
| 144 | " | Rancid | " | " | " | " | " |
| 168 | " | " | Slight off-flavour | " | " | " | " |
| 216 | " | " | Rancid | Slight off-flavour | Slight off-flavour | Slight off-flavour | Slight off-flavour |
| 240 | " | " | " | Rancid | Rancid | Rancid | Rancid |

taining upto 0.3% vanillin, and beyond this level of vanillin, the titratable acidity remained practically constant.

Effect of vanillin on the organoleptic quality of the shortening: Table III shows, that the shortening did not become rancid so long as the peroxide values were within the induction period.

The samples having 0.3-0.6% vanillin did not develop any off-flavour until the ninth day of storage after which slight off-flavour could be discerned. However, by the tenth day, even the shortening containing 0.6% vanillin became rancid and the typical odour of vanillin could no longer be perceived.

The organoleptic observations and the results of chemical evaluation of rancidity show that vanillin does act as an antioxidant.

Summary

The effect of vanillin on the stability of vegetable shortening (m.p. 37°C) was studied under accelerated conditions of storage at 100° ± 2°C by chemical and organoleptic tests.

Vanillin has been found to possess antioxidant properties when incorporated in the shortening.

The interference of vanillin in the Kreis test has been observed, whereas there was no interference in the determination of peroxide values by the iodometric method.

The authors are grateful to Dr. V. Subrahmanyam, Director, for his kind interest and encouragement.

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STUDIES ON THE COMPOSITION, STORAGE AND NUTRITIVE VALUE OF PALM OIL

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During recent years the production of hydrogenated vegetable oils has been on the increase and there is a growing demand for the oils suitable for hydrogenation. There is thus an urgent need to investigate the suitability of other sources of vegetable oils to supplement groundnut oil, for the production of hydrogenated products.

Palm oil is an orange coloured oil derived from the outer pulp of the fruit of oil palm (*Elaeis guineensis* and other allied species). Although the oil has been used for edible purposes for many years, little information is available about its keeping quality and nutritive value.

The present paper deals with the studies on the composition, stability and nutritive value of palm oil, and a blend of palm oil and hydrogenated groundnut oil as compared to hydrogenated groundnut oil.

Experimental

Characteristics and composition of different fat samples: Samples of palm oil, palm oil blend and hydrogenated groundnut oil used in the present investigations were kindly supplied by the Hindustan Vanaspathi Manufacturing Co. Ltd., Bombay.

The official methods of the A.O.C.S.¹ were used in determining the different physical and chemical characteristics of the oil. The melting

point of the samples was determined by the V.O.P. method². The iodine value was determined by the Hanu's method.³ The glyceride composition of the oils was calculated from the thiocyanogen and iodine values. The results are given in Table I.

TABLE I. Chemical characteristics of different fat samples

| | Palm oil* | Palm oil† blend | Hydrogenated groundnut oil |
|---|---|-----------------|----------------------------|
| Consistency ... | Semi-solid (Separating into liquid and solid fractions) | Solid (Grainy) | Solid |
| Melting point (V.O.P. method) ... | 31.5°C | 36.5°C | 36.5°C |
| Saponification value ... | 202 | 198 | 196 |
| Iodine value (Hanu's method) ³ ... | 48.7 | 56.2 | 62.1 |
| Thiocyanogen value ... | 39.5 | 52.0 | 61.4 |
| Olein % ... | 34.1 | 55.55 | 71.39 |
| Linolein % ... | 11.2 | 4.86 | 0.48 |
| Saturated glycerides % | 54.7 | 39.59 | 28.13 |
| Carotene (microgram)% | 260 | 30 | Nil |
| Initial free fatty acids (% oleic) ... | 0.21 | 0.08 | 0.05 |

* Refined and deodorised palm oil.

† Palm oil Blend (m.p. 36.5°C).
Hardened Palm oil 50%
Hardened groundnut oil 45%
Sesame oil 5%

TABLE II. *The keeping quality* of different fats with and without the addition of antioxidants and synergists (Stored in closed tin containers at 37°C)*

| Period (months) | Palm oil | | | | Blend | | | | Hydrogenated groundnut oil | | | |
|-----------------|----------|------|----------|---------|---------|------|----------|---------|----------------------------|------|----------|---------|
| | Control | C.A. | BHA + CA | PG + CA | Control | C.A. | BHA + CA | PG + CA | Control | C.A. | BHA + CA | PG + CA |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 3 | 2.5 | 2.5 | 2 | 1 | 2.5 | 2.5 | 1 | 1 | 1.5 | 1 | 0 | 0 |
| 6 | 2.5 | 2.5 | 2.2 | 2.0 | 2.5 | 2.5 | 2.0 | 1.5 | 2.0 | 1.5 | 1 | 1 |

* followed by estimating peroxide values which are expressed as ml. of 1 N thio per Kg. of fat.

TABLE III. *Acidity of different fat samples (Stored at 37°C for six months)*

| Oil | Free fatty acids (expressed as % oleic acid) | |
|---|---|-------|
| | Initial | Final |
| Palm oil ... | 0.21 | 0.24 |
| Blend of hydrogenated palm and groundnut oils ... | 0.08 | 0.1 |
| Hydrogenated groundnut oil ... | 0.06 | 0.06 |

Stability of palm oil, palm oil blend and hydrogenated groundnut oil: The keeping quality of the different fats was studied by storing them in 1 lb. sealed cans at 37°C for a period of six months, and following the acidity and peroxide values of the fats at different intervals. The effect of addition of certain antioxidants *viz.*, butylated hydroxy anisole and propyl gallate along with a synergist-citric acid, on the keeping quality of the different fats was also studied. Butylated hydroxy anisole, propyl gallate and citric acid were added to the different fats at 0.02 per cent, 0.01 per cent and 0.005 per cent respectively. The free fatty acid content of the control samples was determined at the beginning and at the end of the experimental period. The results are presented in Tables II and III.

Nutritive value of the different fat samples: For assessing the relative nutritive value of the three fats, the following experiments were carried out with albino rats.

- (1) The growth-promoting value of the different fats, when incorporated at 10 per cent level in a synthetic diet,
- (2) The digestibility co-efficient of the different fats, and,
- (3) The effect of different fats on the metabolism of calcium and phosphorus in rats.

Growth-promoting value of palm oil, palm oil blend and hydrogenated groundnut oil. Three groups of freshly weaned rats, about four weeks old and weighing between 40-45 g. were used in these studies. Each group contained ten rats, distributed equally according to sex and litter mates. The three groups of rats were fed *ad lib* on the experimental diets containing palm oil, palm oil blend and hydrogenated groundnut oil. The composition of the experimental diets is shown in Table IV.

TABLE IV. *The composition of the experimental diets*

| Component | per cent |
|--------------------------------------|----------|
| Casein ... | 12 |
| Corn Starch ... | 60 |
| Sugar ... | 10 |
| Vitaminised Starch* ... | 4 |
| McCormick and Davis Salt Mixture ... | 4 |
| Fat† ... | 10 |

* 4% Vitaminised starch in the diet supplied the daily requirements of all B-group vitamins.

† The fats included are ¹refined and deodorised palm oil, ²palm oil blend and ³hydrogenated groundnut oil.

The different fats were incorporated in the experimental diets at 10 per cent level. In addition to the diet, two drops each of Adexoline and alpha-tocopherol were given orally to each

rat, twice a week to meet their vitamin A, D and E requirements. The feeding was carried out for a period of eight weeks. The average increase in weight of the rats is given in Table V.

TABLE V. *Growth promoting value of different fats*

| Fat fed | Average food intake per rat per day (g) | Average weekly gain in weight (g) |
|--------------------------------|---|-----------------------------------|
| Palm oil ... | 11.6 | 13.36 |
| Palm oil blend ... | 11.5 | 13.88 |
| Hydrogenated groundnut oil ... | 11.5 | 14.15 |
| | | ± 0.820 (16 d.f.) |

Digestibility of palm oil, palm oil blend and hydrogenated groundnut oil: The digestibility co-efficients of palm oil, palm oil blend and hydrogenated groundnut oil were determined on adult rats, by feeding diets containing the different fats at 10 per cent level. The method adopted was similar to that of Cheng *et al*⁴. The composition of the diets was the same as that given in Table IV. Calculation for digestibility co-efficients were made in the usual manner after correction for metabolic fat. The results are given in Table VI.

TABLE VI. *Digestibility of different fats*
(Experimental period 7 days)

| Fat fed | Average co-efficient of digestibility % |
|--------------------------------|---|
| Palm oil ... | 96.6 |
| Palm oil blend ... | 96.8 |
| Hydrogenated groundnut oil ... | 96.1 |

Effect of palm oil, palm oil blend and hydrogenated groundnut oil on calcium and phosphorus metabolism in rats: The effect of incorporation of

the different fats at 10 per cent level in an adequate diet on the calcium and phosphorus metabolism was studied in growing albino rats. The composition of the diets were the same as that given in Table IV. Three groups of growing albino rats (about 6 weeks old, and each rat weighing 80-85 g.) were used. Each group contained six rats (3 males and 3 females). The animals were fed on the diets containing the different fats. During the collection period, the rats were kept in individual mesh bottomed metabolism cages with arrangements for the collection of urine and faeces. After a preliminary period of 5 days on the experimental diets, the faeces and urine were collected for a period of six days. The methods adopted for the collection of urine, faeces and diet were the same as those followed by Narayana Rao and Swaminathan⁵. Calcium and phosphorus in urine, faeces and food were estimated according to the methods followed by Murthy *et al*⁶. The results are given in Tables VII and VIII.

TABLE VII: *Effect of different fats on the utilization of calcium in young rats*

(Experimental period 6 days)

| Fat fed | Average food intake (g) | Average amount of calcium consumed (mg) | Average amount of calcium excreted (mg) | | Average calcium balance (mg) |
|--------------------------------|-------------------------|---|---|--------|------------------------------|
| | | | Urine | Faeces | |
| Palm oil ... | 54.8 | 175.4 | 1.7 | 64.7 | 109.0 |
| Palm oil blend ... | 56.1 | 185.1 | 2.6 | 74.8 | 107.7 |
| Hydrogenated groundnut oil ... | 63.5 | 203.2 | 3.6 | 91.0 | 108.6 |
| | | | | | ± 4.34 (8 d.f.) |

TABLE VIII. *Effect of different fats on the utilization of phosphorus in young rats*
(Experimental period 6 days)

| Fat fed | Average food intake (g) | Average amount of phosphorus consumed (mg) | Average amount of phosphorus excreted (mg) | | Average phosphorus balance (mg) |
|--------------------------------|-------------------------|--|--|--------|---------------------------------|
| | | | Urine | Faeces | |
| Palm oil ... | 54.8 | 400.8 | 90.6 | 40.8 | 269.4 |
| Palm oil blend ... | 56.1 | 410.0 | 108.0 | 45.8 | 256.2 |
| Hydrogenated groundnut oil ... | 63.5 | 464.1 | 134.2 | 61.4 | 268.5 |
| | | | | | ± 10.6 (8 d.f.) |

Consumer acceptability of sweet and savoury dishes prepared using different fats: In order to assess the relative acceptability of the different fats as a cooking medium, one sweet dish (Mysore Pak) and a savoury dish (Bhajji) were prepared using the different fats. The consumer acceptability of the preparations was evaluated by a panel of 12 judges selected from among the staff members of the Institute. The results of organoleptic evaluation of the fats are given in Table IX.

The results show that the flavour of palm oil could be easily detected in the sweet dish made from palm oil, but not in that made from the blend. The different fats may be ranked in the following descending order regarding their acceptability in sweet preparations: (i) hydrogenated groundnut oil, (ii) blend of hydrogenated groundnut oil and palm oil, and (iii) refined palm oil. There was no perceptible difference, however, in the flavour and acceptability of the savoury dish prepared using the three different fats.

Results and Discussion

Palm oil has a semi solid consistency, separating into liquid and solid fractions even at room temperature. The results in table I show that it is a rich source of carotene (260 μg /per 100 g) which is a precursor of vitamin A. Palm oil is one of the few vegetable oils which contains carotene. The results on the keeping quality of the different oils (tables II and III) show that palm oil is fairly stable comparing favourably in this respect with the blend, as well as hydrogenated groundnut oil. Addition of citric acid alone is not found to have any stabilising effect on the oils. Addition of butylated hydroxy anisole and propyl gallate along with citric acid is found to

improve the keeping quality of the different fats. No appreciable increase in the acidity of the oils due to storage for a period of six months was observed. The results (table IV) on the nutritive value of the oils show that there is no significant difference in their growth-promoting value. Previous workers^{6,7,8,9} also could not observe any significant difference in the growth-promoting value of different vegetable and animal fats. The three fats, palm oil, palm oil blend and hydrogenated groundnut oil were found to be almost completely digestible in rat. Deuel *et al*⁸ observed that fats which have a melting point below 50°C, are almost completely digested in rat. No significant difference was observed in the retention of calcium and phosphorus in rats fed palm oil, palm oil blend and hydrogenated groundnut oil.

Summary

(1) The present investigation deals with studies on the relative stability and nutritive value of refined and deodorised palm oil, and palm oil blend as compared with hydrogenated groundnut oil.

(2) The physical and chemical constants and carotene content of the three samples of fat were determined.

(3) The keeping quality of the palm oil and the blend was nearly the same as that of hydrogenated groundnut oil.

(4) Addition of butylated hydroxyanisole (0.02 per cent) and propyl gallate (0.01 per cent) along with citric acid (0.005 per cent) enhanced the keeping quality of the different oils.

(5) No significant difference between the growth-promoting value of the three samples of fat was observed.

TABLE IX. *Organoleptic evaluation of sweet and savoury dishes prepared using different fats*

| | Sweet dish (Mysore Pak) | | | Savoury (Bhajji) | | |
|-------------------|-------------------------|-------------------------|----------------------------|-------------------------|----------------|----------------------------|
| | Refined palm oil | Palm oil blend | Hydrogenated groundnut oil | Refined palm oil | Palm oil blend | Hydrogenated groundnut oil |
| Texture ... | Hard | Crisp | Crisp | Crisp | Crisp | Crisp |
| Flavour ... | Marked palm oil flavour | Slight palm oil flavour | Bland | Slight palm oil flavour | Bland | Bland |
| Acceptability ... | Fair | Good | V. Good | Good | V. Good | V. Good |

(6) Palm oil, blend and hydrogenated groundnut oil were found to be almost completely digestible in rat.

(7) No significant difference was observed in the amount of calcium and phosphorus retained by different groups of rats fed diets containing palm oil, palm oil blend and hydrogenated groundnut oil.

Acknowledgement

Our thanks are due to Miss S. V. Chandiramani for help in conducting the organoleptic evaluation of the savoury and sweet dishes prepared using different fat samples and to Miss K. Indiramma for the statistical analysis of the results.

REVIEW SECTION

A SCIENTIFIC APPROACH TO THE FOOD GRAIN PROBLEM*

By V. SUBRAHMANYAN

(Central Food Technological Research Institute, Mysore)

During the past eight years, a great deal of work has been done in our country not only in respect of the nutritive values of certain abundant food materials, but also the utilisation of the latter, on a large scale, for the preparation of cheap and balanced foods that would be acceptable to our people. *This line offers enormous scope and if suitably applied, it will yield at least three times as much food per acre as is now possible without much additional cost.*

Our growing population may outstrip our maximum grain production in thirty years

The use of grains as food represents an important advance in human dietary, going back, possibly a few thousand years, but no other major fundamental advance has since been made largely because the necessity was not actually felt until recently. The scientific efforts, particularly during the past century, have been directed towards increasing the yield of food grains. These have yielded good results and in our own country considerable progress has been made, especially since the Independence. There are, however, certain factors limiting such progress and it is too much to expect more than about 30 per cent increase over our present average production of food grains. Individual farmers may produce extra 100 per cent or more under special

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conditions, but it will be difficult to increase the average yield from land by more than 30 per cent. Even after allowing for this and the additional areas that will come under cultivation during the Second and subsequent Plan periods, the total possible increase in production may not be more than about 40 per cent, above the present level of food grain production. Even this will be largely seen only in the irrigated areas. The rain-fed and other dry cultivated areas are not likely to show any great increase excepting in certain favourable seasons. *Even to obtain this extra 40 per cent, it will take us some decades and by that time, our population which is increasing at over 13 per cent in every ten years will catch up with the production.*

If things continue at the present rate, the chances are that, even before 30 years, we may have to face more than one crisis arising through food grain shortage. This issue will have to be faced with vision and from long range point of view if we have to save the present and more than that, the next generation from the inevitable consequences.

Root crops can yield at least three times as much starchy food per unit acre as grains

It has long been known that root crops, as a whole, give much higher yields than grain crops.

* A note submitted to the Food Grains Enquiry Committee.

To take an instance, tapioca gives an yield of 2-3 tons per acre on even poor soils, whereas on better types of soils such as those on which different grain crops are now grown, a minimum of 10-15 tons per acre can be expected. Even in Kerala, there are areas where the yield is about 10 tons or more per acre. With the necessary care and manuring, the yield can go upto even 20 tons per acre! Assuming a low average of even 3 tons, and allowing for 40 per cent moisture, the yield of starchy food per acre will be at least 3 times as much as rice which is the heaviest yielder among our commoner food grains. It will follow, therefore, that if we can make even partial use of root crops, our difficulties will be far less than it is otherwise likely to be.

Partial replacement of food grains with tapioca and sweet potato

Between 1949 and 1953 we carried out an extensive programme of feeding trials and nutrition work on the partial replacement of different foodgrains with root flours. It was found that upto 25 per cent the foodgrain can be replaced, especially with tapioca, without any ill effect. In most cases there was actually improvement in growth-rate as the result of the replacement.

Representations have been made from time to time about introducing wheat atta and other flours with about 25 per cent tapioca flour in the composition. Suggestion was also made that this could be done at the milling stage. There is, however, likely to be practical difficulty in keeping the control over the quality of the retailed product. The retailer may add a further quantity and it will be very difficult to keep a check on this. It is also recognized that an excessively large proportion of tapioca will considerably reduce the food value of the mixture because tapioca is highly deficient in protein.

It is interesting to note that, in spite of the above practical difficulties, the Government of Philippines legislated in the early fifties for the incorporation of 30 per cent tapioca flour along with wheat flour so as to make up for the deficiency of wheat.

A practical approach to meeting foodgrain deficiency, especially in areas which are known to be chronically deficient is to encourage people to grow tapioca as a garden crop. This is already being done in Kerala. Even a small kitchen

garden can give enough starchy food to sustain a whole family for a few months. The root can be left in the soil for some months and can be dug up as and when required. An alternative will be to dry the chips and use the flour along with foodgrains or other flours.

Some years ago, when there was acute shortage of foodgrains in Rayalaseema, the then Famine Commissioner (of the combined Madras State) introduced tapioca on our recommendation. The root came out fairly well in several parts of Anantapur District and the yields were encouraging. This work deserves to be continued and the people should be taught not only the method of growing tapioca (which is not difficult) but also that of using it for different types of dishes.

Root crops are generally deficient in proteins

While they are good sources of starch, root crops are highly deficient in protein and hence they are condemned by nutrition authorities. Tapioca contains hardly half per cent protein. As the daily adult requirement of protein is of the order of 70 g. one will have to consume about 35 lb. of tapioca per day—which is physically impossible. A similar argument will also apply to sweet potato. It is because of this reason and the fear that unrestricted production of tapioca will lead to excessive consumption that health authorities in different parts of the world have been discouraging the extended cultivation of tapioca. Such restriction is not however the best solution. The most practical approach will be to produce the tapioca and to enrich it with protein in such a way that the deficiency is automatically made up.

Our consumer trials have shown that sweet potato is not likely to find as much favour as tapioca. It may be mentioned however that there are now varieties of sweet potato which are not very sweet and are naturally rich in carotene (precursor of Vitamin A). The improved varieties of sweet potato are being largely consumed in Japan where it forms about 40 per cent of the starchy food of the people.

Production and uses of enriched tapioca flour (Mysore flour)

During the early fifties, there was extensive shortage of foodgrains in different parts of India—and particularly in the South—with the result that

conditions of distress were felt and relief had to be provided by the States. The Central Food Technological Research Institute, Mysore, had an opportunity to assist in this effort and we provided wholesome food to thousands of people in the (then composite) Madras and Mysore States. The Government's policy was then to open community gruel centres and we provided the entire quantity of flour used in several of the gruel centres. We distributed a product known as 'Mysore Flour' at about half the cost of the grain flour which was previously being used by the Government. 'Mysore Flour' consisted of a mixture of white tapioca flour (75 per cent) and specially prepared groundnut flour (25 per cent). The product was supplied at a cost of about 2 annas per lb. and it contained about 13.8 per cent of protein (twice as much as in rice) besides adequate amounts of vitamins and minerals. The consumers actually liked them in preference to other flours that were being used for making gruel or cooked balls. In Mysore State (Hadadi in Davanagere Taluk) we were petitioned by the people to continue with the supply even after the conditions had improved!

While roots suffer from deficiency of proteins, products like groundnut and sesame meals (after expression of oil) contain excess of proteins (over 45 per cent). They are not used as human food. In many parts of the country, groundnut meal is not even used as animal food. This is an unfortunate state of affairs because there is extensive protein malnutrition in our country. We produce no less than 5 million tons of groundnut which yield about 2.5 million tons of meal and that alone should suffice to fortify about 20 million tons of tuber flour to the same level as rice! Extensive series of nutrition studies have shown that 10-12 per cent addition of groundnut meal will suffice to fortify tapioca flour.

Case for the production of oilseed meals of edible quality

The main trouble about groundnut meal as now produced in the country is its quality. If some care is taken to select the kernels and to remove the outer skin after gentle roasting, we can produce a high class meal of edible quality after pressing out the oil. Such a meal can be produced at a cost not exceeding Rs 350 per ton and it will contain 45-48 per cent protein, which

is about five times that of wheat. Hexane extracted meal will be very useful both because of its good keeping quality and higher protein content (over 50 per cent); but even expeller meal can be used provided it is prepared carefully and kept in the form of pressed slabs and used as and when required. As a flour, the pressed meal will keep for 2-3 months, which is about the same as that of wheat atta. When admixed with starchy foods like tapioca, the keeping quality is considerably more. *When made into processed foods where it is also pressed and dried, the products have kept for more than three years, which is even more than the storage life of most foodgrains.*

There is a strong case for the increased production and use of oilseed meals of edible quality. Such a meal is best admixed with poor starchy foods. Till such time as we can produce hexane extracted meals, we may concentrate on the production of expeller meals prepared in the manner described above.

The above programme will apply not only to groundnut meal but also to other edible oilseed meals. Sesame meal is even more nutritious than groundnut meal, though its production may offer some practical difficulties. We can easily make a beginning with groundnut meal and then extend the work to other meals.

The Central Food Technological Research Institute is regularly producing and using oilseed meals—particularly groundnut meal—in large quantities and using it for various lines of food processing. The Institute is also using the meal for producing a concentrated food supplement (Multipurpose Food) in which the oilseed meal is a major component. Even 1-2 ounces of the Multipurpose Food incorporated in the daily dietary of a large section of our people will meet most of the deficiencies of proteins, minerals and vitamins.

The Mysore Institute will be glad to assist the Government in any large-scale production and utilization of edible oilseed meals that may be initiated by the Government.

Processing of fortified root flours to produce foods that can be consumed in the same way as food grains

The history of science has shown that there has always been scepticism and even stiff opposition to any attempt at synthesising or otherwise reproducing natural products. Many of them have

not only been brilliant successes, but they have even surpassed the natural products in respect of purity and cheapness. The World is today benefiting considerably through the use of such products.

When the Central Food Technological Research Institute first developed the concept of making a foodgrain corresponding to rice in composition, there was violent opposition and even ridicule from all quarters. The lay-public or the politicians were not the sole opponents. Even a large section of scientists and technologists considered the whole idea to be fantastic and unworkable. Neither encouragement nor support was readily forthcoming, but the work was nevertheless carried through. With such depressing background, the development naturally took a much longer time than would otherwise have been necessary. It took nearly seven years to set up the first plant capable of making a few tons per day. Even now, the product is, by no means, perfect, but some of the major hurdles have been crossed. Further improvements are bound to follow—whether from India or from other countries. This has opened a new line of augmenting our food resources and at the same time improving the nutritional status of our diet.

The first attempt was to produce a *round grain* as a cottage industry with the equipment that can be locally fabricated. The product was demonstrated in Trivandrum in 1950, but, though it was considered to be tasty, it did not have much public appeal. It was then suggested that a product with the rice shape will be more popular. A great deal of subsequent work was done on the subject. Foreign manufacturers were also contacted and as the result of this, the design for a modern type of semi-automatic plant was prepared. It took a long time for the plant to be fabricated and to be set up in Mysore. The present unit is only an experimental-cum-demonstration unit with a maximum capacity of 2 tons per day, but it has nevertheless shown the possibilities in this line. It has already yielded data on the basis of which bigger plants capable of making even 30 or 40 tons per day can be designed. Such plants can each make 10,000 tons or more per annum. Kerala alone has scope for making several lakhs of tons of such product.

The raw materials now used for making the

grain are tapioca flour (65 per cent) groundnut flour (15 per cent) and wheat flour (20 per cent). Wheat flour is being incorporated so as to improve the processing qualities and to strengthen the grain. It also enhances the nutritive value. It is hoped, however, that with some further experience it will be possible to reduce, if not completely eliminate wheat. To produce the product the mixture is ground, thoroughly mixed and sifted. It is then introduced into a mixing tank where about 35 per cent of boiling water is added. On thorough mixing, the product becomes a dough which then passes into an extruding press where it is further kneaded and forced under pressure (about half a ton to the sq. inch) through a die. Immediately below the die is a cutter which moves at a regulated speed. The cut product which is in the shape of rice (it can also be made in other shapes) drops into a pre-drier from which it is automatically carried to a rotary drier functioning at a regulated temperature, humidity and speed. The dried product is again automatically passed through the drier at a higher temperature and then cooled and packed.

The above processing corresponds partly to that of making macaroni products and as, such products are already known the preparation has been provisionally named 'Tapioca Macaroni'.

Tapioca macaroni as now made in Mysore contains over 10 per cent protein which is about twice that contained in rice. The product is clean and contains no dust, dirt or other impurity. It is cooked by being introduced in instalments into vigorously boiling water (6-8 times the weight of the grain). The cooking is complete in 4-5 minutes after which the gruel may be drained out. Slight washing of the cooked grain improves the individuality of the grain.

The cooked product is soft and tasty and can be admixed with the usual soups, curries, meat, fish etc., as may be desired. The gruel is also tasty and can be consumed either as such (after addition of salt) or along with the rice.

The product was first demonstrated to the Kerala State authorities who expressed a desire to have the trials extended on a much bigger scale. Accordingly, regular production at Mysore has been organised and the product is being demonstrated and also sold to the public to

the extent that supplies are available. The product has so far been well received by the consumers and they are also appreciative of the advantages arising from its use.

The raw materials for the product, as now made at Mysore are rather costly as the main components have to be imported from Kerala and elsewhere. It is expected however that when the production is organised in Kerala itself and on a large scale, the cost will come down considerably. The product is now being sold to the public at 20 nP. per lb. which would make it distinctly cheaper than the price at which rice is now available.

The above development, though started on a small scale represents the beginning of a new line and holds out considerable possibilities for the future. The immediate scope is in respect of Kerala which is already a big producer of tapioca. That State is now importing about 7 lakhs of tons of rice per year at a recurring cost of about 35 crores of rupees. If even a part of the shortage is met by the production of the new product, it will save the State some crores of rupees. The money will stay in the State and provide additional employment. It will also help to steady the price of tapioca which is now subject to considerable fluctuation. There are some seasons in which the price of tapioca comes so low that it is found hardly worth while to lift the crop from the field.

The progress of the above effort is being watched with keen interest by the Prime Minister and other leaders of the country. The Ministry of Natural Resources and Scientific Research has provided the necessary funds for the plant and production of several tons for trials. The Director-General, Scientific and Industrial Research has taken very keen interest and sanctioned every facility for the production and demonstration. The Vice-Chairman of the Planning Commission recently visited the plant at Mysore and expressed his appreciation of the effort. The Kerala Government itself is keenly interested in the successful outcome of the trials, after which plans will be made for production on a large scale. The Central Government has already given the assurance that, if the trials are successful, the necessary funds will be made available for setting up the first plant that will make 20-30 tons per day.

In addition to the interest shown in our country the above effort is also being watched with keen interest in other countries. The Government of Ceylon is interested in setting up similar plants. Other countries have also been following closely on similar lines. Since the Mysore Institute started work, no less than 8 substitutes for rice have appeared on the World Market. The Japanese set up plants for production, but their raw materials proved to be too costly. The work at Mysore has gone on along systematic scientific lines with due consideration for economy. As the immediate object is to meet at least a part of the urgent requirements of Kerala, the process has been adjusted to suit the raw materials of the region. A certain percentage of wheat is now being added primarily to improve the physical properties of the product and to some extent, the nutritive value. It is, however, hoped to reduce if not completely eliminate—wheat in the composition. It is also proposed to make as much use of sun-drying as possible. Even mechanical drying is not costly (the inclusive cost of processing on a large scale together with drying, is estimated in other countries to be equivalent to only about Rs 50 per ton), but in our own country every item of economy that is introduced will help to reduce the cost to the consumer.

Need for continued scientific research and application of processes and methods developed

While there is every need for optimism, it will be very hazardous if we go on depending exclusively on the traditional methods of foodgrain production. We should be prepared for more than one crisis in the course of the next few decades. Our increase in population has lately been faster than before, so that we have reasons to fear that even before the next thirty years, we may reach the danger point—unless there is a drastic reduction in the rate of increase of population—which now appears to be rather unlikely. It is in fact expected that, even if we introduce very efficient methods of population control, the effect will not be felt for another 25 or 30 years. By that time, we would have almost reached the critical stage.

In our country, most of our developments are based on work done in other countries. All our machinery are ready made equipment and

our industrialists only instal and work them. As the result of this, there is very little understanding—let alone appreciation—of the problems connected with process development. Now ideas are ridiculed and attacked even before they are developed. An original thinker and worker in our country is considered to be a crank who may be humoured, but who should be eventually put down. Under such conditions, there is very little incentive for original work.

Anyway, the stage has now come when we have to make a bold approach and try out every promising line or, alternately, leave the inevitable legacy of suffering to the succeeding generation.

Our effort in regard to producing cheap fortified flours and composite grains may not be perfect, but they represent a beginning in a new line. This effort deserves much more recognition and encouragement than it has so far had. Improvements are bound to follow and better and better products are certain to be made. Even as it is, we have something with which we can make a beginning.

The Food Grains Enquiry Committee has a major responsibility in respect of not only the feeding of the people, but also the economy of the country. If there is any major crisis in food production—through reasons beyond our control, it will result in a terrific catastrophe which will also result in a major political and other upheaval in our country. If we have to progress steadily, our first concern will be to see that our people are all fed and given wholesome food. The suggestions made in this note are made on the basis of experience and with a realistic background. It is earnestly hoped that the Committee will not only give kind careful consideration to the present note but also find time to visit Mysore and see the process involved. It is hoped that there will also be an opportunity to further explain the implication and to discuss the practical problems with the committee at a meeting which, it is hoped, can be arranged in Mysore itself.

Need for a central organization for the development, conservation and better utilization of the available as well as the potential food resources of the country

One of the first Acts of the British Government in the early days of the Second World War was to create a high power organisation for food

planning under the leadership of the late Sir J. C. Drummond. This organisation which was directly under the Minister for Food determined not only the extent to which the different categories of food materials should be imported but also the ways and means of augmenting the National food resources. As the result of this, the imports were reduced to a minimum. At the same time, through careful planning, the nutritional status of the people was considerably improved. In our country, we have large quantities of good class food materials which are not being properly utilised. We also have potentialities for raising additional food materials which could supplement our existing food supplies. A good deal of information is already available, but it has so far found very little application. The time has now come when we should reorient our whole approach. Increased production of foodgrains, as also other enriched and fortified foods, should go on side by side. Protective foods should find a permanent place in our planning. The Ministry of Food and Agriculture should get the assistance of the best available people in the country and there should be a small central team engaged whole time not only in planning but also in the development of fresh food resources. The Organisation thus set up should have the necessary status and executive powers. Otherwise, there will be no progress.

It has been repeatedly expressed by the leading scientists in the country that scientists and scientific work are not receiving the necessary respect and consideration at the hands of administrators. In view of the continued drain of money from the country on foodgrain purchases and the possibility of other crises through periodical shortages, there is a most urgent need for the subject to be placed on the same footing as Britain did during the War. A similar recommendation was made by Lord Boyd Orr, the first Director-General of the Food and Agriculture Organisation, when he was invited by our Government to advise about our food problem. The subject deserves the most urgent consideration and it is hoped that the proposal made in this note will receive the necessary strong support from the Food Grains Enquiry Committee and the other leaders of the country.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during August–September 1957 are given below :

S (IS) 213 (160)

Size of experiments in Food Research, by A. N. Sankaran and Miss K. Indiramma, (August 31, 1957).—Introducing the subject, Mr A. N. Sankaran said that on account of the natural variation in the biological material, it is not sufficient for drawing valid inferences, to carry out experiments with a single replicate only. It is necessary to carry out experiments with sufficient number of replications so that, while interpreting the data from tests of significance, the risks are small and of pre-assigned magnitude, in declaring that a treatment effect is significant when in fact there is no effect and that the treatment effect is not significant, when in fact the effect is real and of a given magnitude.

Miss K. Indiramma, presenting the paper, explained the classical Tea Tasting Experiment described by Prof. R. A. Fisher and indicated how the confidence of the experimenter in the discriminating capacity of a judge in a tasting experiment is increased by enlarging the size of the experiments. She outlined the fundamental ideas in tests of significance and also introduced the ideas of the errors of the first and second kinds *viz.*: (i) of rejecting a true hypothesis and (ii) accepting a false hypothesis. She explained these ideas with reference to a hypothetical normal distribution and indicated how the size of the experiment needed for drawing valid inferences depended upon the degree of variability, the magnitude of an effect desired to be detected and the degrees of risks which can be tolerated in committing errors of the two kinds. Dealing with experiments on the storage preservation

of fruits and vegetables, she presented data on the minimum number of fruits to be kept under each treatment for detecting decreases of given magnitude in the damage percentage under a new treatment when compared with control, corresponding to 5 per cent and 10 per cent risks in committing errors of the first and second kinds respectively. She then illustrated feeding experiments with rats and mentioned that the extent of variability in the gain in weight measured by the mean square error in the analysis of variance was linearly related to the average gain in weight. She explained the significance of one-tailed and two-tailed tests and indicated the number of rats to be used per group for detecting differences of given magnitude in the nutritive value of different foods. She also explained that these numbers will be different depending upon whether the test of significance to be used is on one-tailed basis, (e.g., experiment on the supplementary value of proteins, effect of fumigation on the nutritive value of food grains, etc.) or on two-tailed basis, when the direction of difference is immaterial. Charts were then presented giving the number of rats to be used in experiments involving 2, 3 and 4 diets separately for males and females and also for one-tailed and two-tailed tests. She then described institution feeding experiments and presented tables giving the minimum number of children to be fed under each diet for detecting differences of given magnitude in increases in height and weight.

She then dealt with experiments on the comparative efficiencies of two methods of brewing coffee and

explained how the confidence intervals giving estimates of the true quantity of total soluble solids extracted could be narrowed by increasing the number of trials. She concluded by saying that the size of experiments depended upon (i) the extent of variability of the character in the material (ii) the minimum difference desired to detect, (iii) the magnitude of the two kinds of risks which could be tolerated, (iv) the type of design used (v) the nature of ancillary information collected and (vi) the availability of resources.

Prof. S. K. Ekambaram, speaking next, drew attention to the possibility of carrying out experiments with less number of replications by adopting the sequential procedure. The experiment is carried out with a certain number of replications to start with and after carrying out the statistical analysis of the data from these replications, it will be possible either to say conclusively about its significance or to say that the results are inconclusive and that the experiment should be repeated with some more replications. In the long run, the average number of replications in an experiment where the sequential procedure is employed will be less than that where the simple non-sequential procedure is followed. Mr. Sankaran replied by saying that the sequential procedure could be followed in experiments where the question of time involved for repeating the experiments with additional replications when the results from the preliminary replications are not conclusive is not important. He cited the case of tasting experiments, experiments involving titrations, etc. But it is not advisable

to use the sequential procedure in experiments which cover a few months, like the animal feeding experiments, institution feeding experiments etc. In experiments on the storage preservation of fruits, we have to wait for the next season (i.e., one year), when the results from the preliminary experiments are not conclusive.

The President in his concluding remarks re-emphasised the need for carrying out experiments with sufficient number of replications and also the need for consulting the statistician before the experiment is started.

S (IS) 214 (161)

Problems of the Indian Preserves Industry, by Lal, Girdhari (*September 28, 1957*)—‘Murrabba’ or Preserves which had been prepared for a long time past by indigenous methods came under close scrutiny of the F.P.O. Laboratory since 1953.

During the first three years of analysis of 835 samples, it was found that more than 50 per cent of them did not conform to specifications. The major defects were:

- (1) Fermentation
- (2) Low soluble solids contents and
- (3) Crystallisation of sugars.

The speaker then described the methods of manufacture and the present status of the industry. There are 74 factories licensed under the Fruit Products Order dealing with only preserves, and 80 per cent of the total production in the country is in Delhi and Amritsar. The estimated production of preserves in this country is to the tune of 3,000 tons valuing Rs 33 lakhs. Then the speaker dealt with the salient features of the report of the Murrabba Sub-Committee which was affirmed by the Central Food Products Advisory Committee (Ministry of Food and Agriculture) early in 1956.

It was observed that:

- (i) All the factories were situated in thickly populated

areas under unhygienic surroundings;

- (ii) No boiler was used and the preserves were being made only on Bhathies;
- (iii) Area of the factories varied from 50 sq. ft. to 1500 sq. ft.;
- (iv) Fruits were not being washed and there were no peeling tables;
- (v) Due to restricted space, the peeling was done by factories at other premises which were not very hygienic;
- (vi) With few exceptions, no quality control was being observed during the processing of the products;
- (vii) Flow of raw materials from process to process was not systematic;
- (viii) Packaging and processing was defective.

Observing this state of affairs, the Committee recommended the shifting of these factories immediately to healthier surroundings earmarked as Industrial areas and that all possible financial assistance should be rendered to the Industry by Central and State Governments in this direction. Packaging murrabba in hermetically sealed containers by 1st April 1958 was recommended which has been accepted by the Government.

The Committee felt that there is immediate need for setting up a regional research station, somewhere in North, where this industry is localized.

The speaker then revealed the research programme as laid down by the Committee for example: the study of lack of uniformity in the consistency of preserves with special reference to penetration of sugar; fermentation and darkening of the preserves during storage. Researches done at this Institute for the past two years or so indicated that:

- (a) Murrabbas are not a good source of B group of vitamins;

- (b) Initial fermentation does not help in improving sugar penetration;
- (c) There was no correlation between alcohol content and initial fermentation.

Furthermore, research work has been conducted on:

- (i) Chemical and microbiological analysis of some important canned preserves like *Amla*, *Behi* (Quince), *Apple*, *Bel*, ashgourd and carrot with particular reference to their polyphenol contents;
- (ii) Changes in ascorbic acid and polyphenol content during preparation of *Amla* preserve;
- (iii) Retention of β -carotene during preparation of carrot preserve.

The talk was then followed by an interesting discussion where various points were raised e.g., cost of the product in hermetically sealed containers, improving the method of manufacture, partial dehydration of the product, discreet packaging of different Murrabba products and the need of standard specifications for Murrabba.

Concluding, the President emphasised for the objective approach to the problem and felt the need of improving the method of manufacture by which we can make the product (e.g., Myrobolan) more palatable and accessible. It is further important that for export purposes, the use of modern scientific methods in their manufacture are adopted. He further stated that hermetic sealing will be alright for bigger packs, but as retail sales are in vogue for smaller amounts, this type of hermetic packing may not meet the requirements of the common man. This evidently required more investigations for finding out suitable small packaging material e.g., polyethylene, pliofilm etc.

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Bacterial load in pickles

E (M) 22001 (388)

Will you kindly inform us about the causes for the high bacterial load found in pickles? How can it be remedied? (Bombay).

Many spices are used in the preparation of pickles and most of these spices carry heavy loads of bacteria and fungi. As long as the moisture content remains below 10 per cent, they are safe. But during storage and transit as the moisture increases, first fungi begins to appear and later on bacteria. Hence there is necessity to treat the raw materials (spices) with antifungal agents (formalin in vapour phase or some suitable quarternary ammonium compound or sorbic acid) depending upon the type of fungi and bacteria. After pretreatment they should be dried to bring down the moisture to 10 per cent or less and packed.

Sodium benzoate upto 250 p.p.m. is permissible in the pickles. This will check the spoilage.

Spoilage of potatoes

E (S) xxxx (389)

We often find sunken and leathery spots on the 'lurya' variety of potatoes. Please let us know as to what it is due to and how it can be prevented? (Delhi).

The sunken and leathery spots on the 'Lurya' variety sent by you are due to heat injury. Heat injury usually takes place if the potatoes are exposed to the sun in the fields after they are lifted. The injury may occur even when the sun is not bright and the atmospheric

temperature is not exceedingly high. The disease is caused by the invisible heat rays of the sun.

To avoid heat injury potatoes should be picked up within 15-30 minutes after they are dug and stored in a shed. This is especially important if the atmospheric temperature exceeds 90°F in shade. Alternatively, to avoid heat injury, especially during the beginning of summer, the potatoes should be dug late in the afternoon and allowed to cool in the field overnight.

Manufacture of unfermented apple juice

E (F) 15479 (390)

What are the details of the manufacture of unfermented apple juice and under what conditions is it bottled and canned? Kindly write to us about the method of clarifying the juice also. (Delhi).

Raw material: Use low-grade 'cull' fruit (undersized, oversized, mis-shapen, belmished, sound windfalls, etc.) which does not find profitable sale in the fresh fruit market. The fruit should have developed full flavour and aroma before use.

Washing: Give a preliminary washing to the fruit in a weak hydrochloric acid solution (5 gallons of commercial acid in 100 gallons water) to remove all arsenical or lead spray residues, if any. Wash the fruit thoroughly afterwards to remove the acid and other foreign matter like soil. This is particularly useful in the case of windfalls.

Crushing: Crush the fruit in a crusher commonly known as an

'apple grater'*. The grater can be adjusted to grind the fruit to any desired degree of fineness. Adjustment to get pieces of 1/8 to 1/2 inch diameter is recommended as pieces of crushed apples of this size facilitate the extraction of juice.

Juice extraction: Press the juice out of the crushed mass (placed in a strong cloth) in a basket type hydraulic press*. Collect the juice in a non-corrodible vessel, preferably made of stainless steel or monel metal.

Filling and bottling: Strain the freshly expressed juice through a thin layer of cotton wool or a very coarse muslin cloth to remove coarse particles of fruit tissue. Heat the strained juice rapidly to a temperature of 180°—185°F, in a steam-jacketed kettle of aluminium or stainless steel. Pour the juice at once at the above temperature in clean sterilized bottles (previously boiled in water for about half an hour) and fill the hot juice till it overflows the brim of the top of the bottle and immediately seal airtight with crown corks (previously boiled in water for 2 to 3 minutes) by an ordinary hand-worked crown corking machine. Steam-jacketed kettle is recommended as it is more convenient than an open pan on direct fire for heating juice in bulk. In the former, there is likely to be a slight overheating of small portions of the juice in contact with the heating surface (heated by superheated steam) but this effect is much more marked in the case of the latter where the juice is heated on direct fire (careless handling in this case will spoil the juice). Prolonged

* These equipments can be had from M/s. Gardners Corporation 25/70, Connaught Circus, New Delhi

heating should be avoided as it injures the colour and flavour and also augments the oxidation of juice due to its exposure to air during the process of heating.

Pasteurization: Place the bottles, filled by the over-flowing method, horizontally on a removable false bottom of a sterilizer containing water which has been heated to about 175°F, and maintain the bottles after pasteurization by slowly running cold water into the steriliser.

In case the juice is required to be canned, the strained juice can be filled in cans and then exhausted till the temperature of the centre of the can is 175°F. The cans are then closed and pasteurized at 180-185°F (at sea level) for a period varying from 20 to 30 minutes according to the size of the container.

Note: In case the clarified juice without fine particles of fruit tissues is required, then the extracted juice can be clarified by standard tannin-gelatin solutions which can be made as under:

- (i) *Standard tannin solution:* 9.5 gram of pure tannin is added to 200 c.c. of 95 per cent alcohol and volume made upto 1 litre or 1000 c.c.
- (ii) *Standard gelatin solution:* 21.4 gram gelatin is dissolved in 800 c.c. water and volume made upto 1 litre or 1000 c.c. by adding 95 per cent alcohol.

With these standard solutions, each batch of juice processed on a particular day has to be tested to determine the amount of tannin and gelatin required for clarification. On the basis of these tests, the actual amount of tannin and gelatin required are calculated for a particular batch. Firstly the tannin is added and then the addition of gelatin is followed.

In a particular batch in our laboratory, it has been found that the addition of 1.25 oz. and 2.25 oz. of tannin and gelatin respectively were required for getting the maximum clarity in 100 gallons of juice.

It is considered, however, that juice bottled or canned with fine particles of fruit has better flavour than the completely clarified juice.

Cold storage of eggs and limes

E(S) xxxx (391)

May I know what are the optimum conditions to be followed for the cold storage of shell eggs and limes? What would be their cold storage life? How can we avoid the heavy losses in weight of eggs that has been observed in our cold storage unit? (Poona).

The optimum conditions for the cold storage of shell eggs are a temperature of 31-33°F and a R.H. of 85-90 per cent. Since the freezing point of shell eggs is 29°F, care should be taken to see that the temperature in the cold storage chamber does not fall below 31°F. Under these conditions, the storage life of freshly-laid shell eggs is about 8 months. You mention that in the eggs stored by you, the losses in weight were excessive. These losses can be avoided to a considerable degree if the eggs are dipped in liquid paraffin preparatory to cold storage. The period of dipping in liquid paraffin should, however, be reduced to the minimum.

The optimum conditions for the cold storage of limes are: Temp. 47-50°F; R.H. 85-90 per cent. Fully grown but green limes should be preferred for cold storage as against turning or yellow limes. Limes should be packed in 4-gallon-kerosine tins which should be covered with wooden planks. Under these conditions the storage life of limes is about 8 weeks.

Fortification of peanut butter

E (IS) 12654 (392)

Please let us know as to which of the vitamins are suitable for the fortification of peanut butter and at what levels can they be added. (Bombay).

Generally, the level of fortification of peanut butter with vitamins should be within the same range as fresh butter as far as vitamins A and B are concerned. In order to fortify the peanut butter with other-

vitamins also, we recommend the following levels:

| | |
|-----------------------|---------------------|
| (1) Vitamin A | ... 250 I.U./100 g. |
| (2) " D | ... 50 I.U./100 g. |
| (3) Riboflavin | ... 2 mg./100 g. |
| (4) Calcium pantothe- | |
| nate ... | ... 2 mg./100 g. |
| (5) Pyridoxine | ... 1 mg./100 g. |
| (6) Thiamine | ... 1 mg./190 g. |

The other B vitamins are present in adequate quantities in peanuts.

Preparation of Grape Wine

E (IS) xxxx (393)

Would you be kind enough to furnish us the details of the method of preparation of wine from grapes? (Bangalore).

Select ripe, fresh grapes and remove the blemished portions, if any. Crush the grapes as such and extract the juice by putting them in a thick cheese cloth, and pressing the same in a small screw type basket press thereby getting the maximum yield of the juice. The juice containing the coarser pulp of the fruit is pasteurized at a temperature of 140°-150°F for about 30 minutes which process helps to inactivate the wild yeast flora to some extent in settling the dirt etc.

Syphon off the clear juice into a clean carboy and adjust the sugar content (Brix reading) of the juice to 23° Brix either by the addition of sugar, if the original content is low, or by diluting the same, if it is high. To the culture bottle of pure strain of *Saccharomyces Eilipsoideus* Var. *Burgandy* (which can be had from any recognized bacteriological laboratory) add about 3-4 ounces of pasteurized juice (just sufficient to cover the agar slant on which rests the culture) under sterile conditions, so that wild flora do not get into the culture bottle. Allow the organisms to multiply. After 2 hours a frothing on the surface of the juice will appear indicating that the fermentation is complete. This fermented juice is poured into a similarly pasteurized juice in the ratio of 1:10 which in another 24 hours will be completely fermented so that further multiplications are carried out in the same propor-

tions at a temperature maintained between 80°-85°F. When, however, the fermentation slackens the aeration of the fermenting juice is carried out by means of an air-pump (only filtered air free from wild flora being admitted for the purpose). The fermentation process takes about 21 days when all the sugars get converted into alcohol.

The wine is racked by syphoning out the clear supernatant liquid and discarding the precipitate which is largely yeast and other organic matter. This process is repeated a number of times by sealing the syphoned wine in air-tight containers and observing the accumulation of a sediment during the course of storage. To the fairly clear wine are added oakwood shavings, which through oxidation impart an agreeable oaky flavour during the course of storage for a year or even more. The wine when ready is bottled and pasteurized at 140°-150°F. for 30 minutes.

Preparation and uses of Banana Chips

E (IS) xxxx (394)

I would be highly obliged if you can supply me the necessary information regarding the method of preparation and uses of banana chips. (Raichur).

Select round raw bananas, free from injuries and with as little sugary taste as possible. Any variety may be used for the purpose. Washing is not necessary, but dirt and other extraneous matter sticking to the fruit may be removed by rubbing with a piece of wet cloth. Peel the fruit by hand after giving three or four longitudinal cuts to the peel with a sharp stainless steel knife. Remove the end tips and cut the peeled fruit into slices, 1/8"—3/16" thick, with a sharp stainless steel knife or a mechanical slicer. *Use of any equipment of ordinary steel for slicing will stain the fruit black and should, therefore, be avoided.* Keep the peeled fruit as well as the slices immersed in water or preferably in a solution of 0.1 per cent citric acid or tartaric acid, 0.05 per cent hydrochloric acid or 0.1 per cent potassium metabisulphite to avoid browning.

Remove the slices from the medium in which they were kept, give them a wash in cold water, drain and spread on wooden slat bottom trays at 1/2-1 lb. per sq. foot of tray surface. Trays made of deal wood strips are suitable, but even trays of bamboo sticks may be used for the purpose. At this stage, sulphuring may be done to improve the quality of the product. For sul-

phuring, the slices on the trays may be exposed for one hour to fumes of sulphur dioxide, by burning sulphur in a special chamber called sulphur box. About 1/4 tola of sulphur may be burnt for one charge of the sulphur box holding 10 trays.

Put the treated slices for drying either in the sun or in a home-drier. In either case, care should be taken to prevent access of outside moisture to the slices. A home-drier is to be preferred since the temperature inside can be easily controlled and drying is quicker. The home-dried product is also superior to the sun-dried one. The temperature in the home-drier should be maintained at 140-145°F. Drying should be stopped when the slices become bone-dry and be broken into small bits when pressed by hand.

Uses: The dried slices can be fried in a suitable cooking medium and served like potato chips or they can be ground into flour in any convenient type of grinding mill. Banana flour has been found suitable to replace a part of wheat flour (the proportions depending upon individual taste) in all preparations where wheat flour is used. Good quality vermicelli and cakes, can also be made out of banana flour alone.

TECHNICAL AID TO FOOD INDUSTRIES (*published in July 1954*), pp. xvi + 270.

This publication contains the views and suggestions of prominent scientists, leading industrialists and food technologists, and Government officials on the nature of technical aid needed by different food industries in the country. Up-to-date technical and statistical data are provided and an appendix embodying the conclusions of the Symposium as well as a comprehensive index are given.

Price: Indian = Rs. 5-0-0 (*postage extra*); Foreign = 10 shillings.

INDIAN FOOD LAWS (*published in August 1954*) pp. v + 220.

This volume summarizes all important details regarding the history, operation and enforcement of the food laws existing in different States in India, definitions, descriptions and chemical standards for articles of food including permissible additives, (colours, flavours and preservatives) and labelling of foodstuffs. The large number of tables on the comparative chemical standards prescribed for different food commodities in various parts of the country make the book useful for reference and guidance for the public analysts and the legal profession.

Price: Indian = Rs. 4-8-0 (*postage extra*); Foreign = 10 shillings.

Notes and News

STATISTICAL NOTES

Food Production Statistics for June and July, 1957

| Name of Industry | No. of Units | Production during June 1957 | No. of Units | Production during July 1957 |
|--------------------------------|--------------|-----------------------------|--------------|-----------------------------|
| Confectionery ... | 34 | 709 tons | 30 | 705 tons |
| Biscuits ... | 30 | 1,351 " | 26 | 1,455 " |
| Flour milling ... | 27 | 48,567 " | 30 | 45,290 " |
| Butter (tinned) ... | 4 | 33 " | 3 | 38 " |
| Cashewnuts ... | 13 | 1,546 " | 13 | 1,770 " |
| Dal and gram flour... | 3 | 829 " | 1 | 306 " |
| Aerated Water ... | 37 | 88,706 gross bottles | 34 | 55,356 gross bottles |
| Beer ... | 2 | 11,433 gallons | 2 | 118,769 gallons |
| Country spirit ... | 20 | 362,561 proof gallons | 13 | 159,372 gallons |
| Indian made foreign liquor ... | 17 | 34,246 gallons | 16 | 55,394 gallons |

(Ministry of Commerce and Industry, Government of India)

All-India Final Estimates of Pulses, 1956-57

| Pulses | Area (thousand acres) | | Production (thousand tons) | |
|------------------|------------------------|------------------------------------|----------------------------|------------------------------------|
| | 1956-57 Final Estimate | 1957-56 Partially revised estimate | 1956-57 Final Estimate | 1955-56 Partially revised estimate |
| Gram ... | 23,990 | 24,157 | 5,930 | 5,331 |
| Tur ... | 5,696 | 5,637 | 2,047 | 1,830 |
| Other pulses ... | 27,609 | 27,270 | 3,358 | 3,660 |
| Total ... | 57,295 | 57,064 | 11,335 | 10,821 |

(Economic and Statistical Adviser, Ministry of Food and Agriculture, Government of India)

BOOK REVIEW

'Yoga-Mimamsa', Volume VI, No. I June 1956, an English Quarterly Published by Kaivalyadhama, P.O. Lonavle (Bombay), Annual Subscription Rs 12.08.

'Yoga-Mimamsa' has resumed publication after a lapse of twenty-one years. It is edited by Swami Kuvalayananda. The publication is based on research work being carried out at Kaivalyadhama on yogic cult and practices. The pursuit of these investigations is motivated to unravel the mysteries of this cult. Once the scientific sound-

ness of the yogic exercises etc., is established, the same can be applied successfully for preventive and curative therapy.

The present issue of the journal is divided into four sections. The first section deals with scientific investigations on different types of *pranayama* as affecting the basal metabolism in human system. It has been proved that *pranayama* does not result in any deleterious effect like increase in the acidity of the urine or change in its pH. The terms acidity and pH have been explained thoroughly for the grasp

even of a layman. The second, third and fourth sections of the journal are devoted to philosophico-literary research in Yoga as related to *pranayama*, techniques employed in yogic exercises and multifarious activities of Kaivalyadhama respectively.

All the chapters, comprising of 80 pages, are given in lucid style with 16 full page illustrations on glazed paper. The Kaivalyadhama has undertaken an onerous and uphill task which requires sound and systematic planning of experiments and correct interpretation of data obtained by these studies as the margin of error is quite large in studies of this nature. It is expected that these studies will open a new vista not only for spiritual attainments but for physical well-being also. The utility of this organ will be felt more and more with the passage of time.

J. C. ANAND

C.F.T.R.I. NEWS

The following distinguished persons visited the Institute during October 1957.

4-10-1957. Dr Majumder, Director of Industries, Bihar.

5-10-1957. Mr Pantszu-Li, Chinese Ambassador in India, New Delhi.

11-10-1957. Shri A. M. Thomas, Deputy Minister for Food, Government of India, New Delhi. He also addressed the Staff of the Institute on the food problems of the country.

21-10-1957. Prof. Boluhis, Professor of Tropical Food Crops, Netherlands.

25-10-1957. Shri B. Vaikunta Baliga, Minister for Labour and Law, Government of Mysore.

26-10-1957. Dr Ahmed, Minister for Agriculture, Government of West Bengal. He also addressed the staff of the Institute.

Mr Bruce Coman, U.S. Information Service, Madras.

29-10-1957. Shri C. M. Poonacha, Minister for Home Affairs and Industries, Government of Mysore.

Mr Home Wood, Engineer, Nestle's Products Limited, Switzerland.

Appointments and Postings:

Senior Scientific Officer

Shri G. L. Tandon (Fruit Technology Division).

Junior Scientific Officers

Shri P. K. Ramanathan (Food Engineering Division).

Shri N. S. Kapur (Food Processing Division).

Dr J. S. Pruthi, (Fruit Technology Division).

Research Assistants

Shri H. N. Bhagvan (I.C.M.R. Scheme).

Shri N. Venkata Raju (I.C.M.R. Scheme).

Nominations

Dr Girdhari Lal, Assistant Director has been nominated as a member on the Committee to be set up in the I.C.A.R. for the establishment of Regional Research Stations for Fruit and Vegetable Production.

List of Papers Published

631. **Studies on the stability of oils in pickles**, by Krishnamurthy, K., *et al.*, *Food Sci.*, 1957, 6 (6), 133.

632. **Analysis of Shati Food**, by Kadkol, S. B., *Food Sci.*, 1957, 6 (6), 135.

633. **Canning of fish**, Digested from the February 1945 issue of Guide to Industrialisation of China, *Food Sci.*, 1957, 6 (6), 137.

634. **Analysis of field beans (*Dolichos Lab Lab*) at different stages of maturity**, by Rama Rao, G. and Kadkol, S. B., *Food Sci.*, 1957, 6 (7), 153.

635. **Water extractable nitrogen in Indian pulses**, by Rama

Rao, G. and Kadkol, S. B., *Food Sci.*, 1957, 6 (7), 154.

636. **Lathyrism**, by Subrahmanyam, V., Narayana Rao, M. and Swaminathan, M., *Food Sci.*, 1957, 6 (7), 156.

637. **Adverse weather conditions and seasonal food shortages—A practical approach to the problem**, by Subrahmanyam, V. and Swaminathan, M., *Food Sci.*, 1957, 6 (7), 159.

638. **Detection of adulteration ghee with vanaspati, Part II—Measurement of turbidity temperatures with benzyl alcohol—glycerine as solvent**, by Desikachar, H. S. R., *et al.*, *J. sci. industr. Res.*, 1957, 16B (5), 216.

639. **A study of the movements of some insect pests**

through grain stored in bags, by Sharangapani, M. V. and Pingale, S. V., *Indian J. Entomol.*, 1956, 18 (Part III), 243.

640. **Oxidative enzymes and phosphatases in agave Vera Cruz Mill.**, by Nagabhushanam, A., Srinivasan, K. S. and Srinivasan, M., *J. sci. industr. Res.*, 1957, 16C (6), 127.

Additions to the Library

1. *Practical mycology*, 1953, By Funder, S., (Hafner), pp. 145, \$6.50.

2. *Fungi*, 1952, by Wynd, F. L. (Hafner), pp. 420, \$10.00.

3. *Johnson's note book for tea planters*, 1955, by Johnson, R. J., pp. 490, Rs 17-8-0.



Chinese Ambassador in India and his wife with the Director, during their visits to the Institute

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

A modified aniline chloride test for the detection of technical invert sugar in honey, by Mitra, S. N. and Chatterji, R. K., *Sci. & Cult.*, 1957, **23** (2), 97.—The presence of technical invert sugar in honey is detected by either the Fiehis test or the aniline chloride test. Though in general these tests are applicable, still they give positive test even in the case of over-heated genuine honey. The aniline chloride test gives a red colour with over-heated honey. The authors describe a modified test which overcomes this difficulty and gives a negative result with genuine honey even if over-heated. The details of the test are given. The sample of honey is diluted and aniline chloride solution added to it. The two are mixed well by gentle shaking for half a minute and allowed to stand for an hour when two layers are formed. The upper layer will be red in colour if technical invert sugar is present, while with genuine honey the layer will have a white to buff colour. In the case of overheated samples, the resulting colour will be somewhat dirty chocolate. By adopting the modified test, it is possible to distinguish between adulterated and genuine samples and also over-heated genuine samples of honey.

K.L.R.

BIOCHEMISTRY AND NUTRITION

The curing of freshly harvested paddy: Part I—Principles of curing, by Desikachar, H. S. R. and Subrahmanyam, V., *J. sci. industr. Res.*, 1957, **16A** (8), 365.—Suitable 'wet heat' treatment of

freshly harvested paddy or an incipient parboiling of the rice just prior to cooking reduces the pastiness, on cooking, of rice. Such heat treatment can be used for curing paddy or rice to enable its use immediately after harvest.

The viscosity of the gruel obtained by cooking under standard conditions or the content of alcohol precipitable solids in the gruel can be used for comparing the cooking quality of rice samples.

The curing of freshly harvested paddy: Part II—Applications, by Desikachar, H. S. R. and Subrahmanyam, V., *J. sci. industr. Res.*, 1957, **16A** (8), 368.—By steaming fresh paddy for 15-30 min. and heaping the hot paddy for 1-2 hrs. before drying it by aeration in the shade, a rice which possesses the appearance and cooking qualities of old raw rice and the nutritional properties of parboiled rice is obtained.

A simple type of rice cooker which can be used to cook freshly harvested rice has been designed for use in the household. As the rice is steamed preliminary to cooking, pastiness during cooking is avoided.

The method of treatment has been applied successfully in rice mills.

Effect of garlic in the diet on the intestinal microflora of rats, by Subrahmanyam, V., *et al.*, *J. Sci. Industr. Res.*, 1957, **16C** (8), 173 — The nature of the diet has a great bearing on the type and number of organisms found in the intestines. These organisms are responsible for various disorders. Spices have been found to correct the disorders. The authors have investigated the effect of incorporating garlic in the diet on the intestinal microflora. Garlic has in it an antibacterial

principle called allicin which inhibits the growth of several micro-organisms. Male albino rats were fed three kinds of diets *viz.*: (1) a stock diet based on whole *ragi* and wheat and rich in 'roughage' (2) rice diet and (3) poor rice diet supplemented with red gram *dahl* at 60 per cent level. The composition of these are given in a table. Rats were fed these diets with and without garlic at 2.5 per cent level. The caecal and faecal contents were collected at the various stages and were analysed for total count, coliforms and anaerobes. The results show that the bacterial counts of the caecal contents and faeces of rats fed on the stock diet and on the poor rice diet supplement with red gram *dahl* are very high as compared to the counts obtained in the case of animals fed on the poor rice diet alone. The incorporation of garlic in the diet considerably brings down the number of coliforms and anaerobes. There is also a considerable decrease in the total count.

K.L.R.

The influence of amino-acids on the autoxidation of ascorbic acid, by Rakshit, P. C., Sen, B. C. and Bhattacharyya, P. K., *J. Indian chem. Soc.*, 1957, **34** (9), 668.—The autoxidation of ascorbic acid in solution has been studied in presence of different amino-acids, like glycine, alanine, glutamic acid, aspartic acid, leucine etc., and amides like asparagine and guanidine. When these compounds are present in molecular proportions to ascorbic acid or in higher proportions, they exhibit a strong stabilising influence on the autoxidation. The amino-acids suffer no chemical change. The stabilising effect decreases with increase of temperature

and pH. It is suggested that this effect is probably due to a kind of loose association with ascorbic acid.

Effect of soyabean inhibitor and vitamin B₁₂ on growth of rice moth larva (*Corcyra Cephalonica* St.), by Sivaramakrishnan, R. and Sarma, P. S., *Curr. Sci.*, 1957, **26** (9), 283.—Earlier workers have observed that the soluble fraction of raw soyabean retards growth in experimental animals fed a normal diet by inhibiting the activity of trypsin. This growth retardation in rats can be overcome by incorporating vitamin B₁₂ in the diet. In view of the great resemblance of the rice moth larva to the rats in its B-vitamin requirements, the AA have investigated whether vitamin B₁₂ has any such role in the insect. The soyabean extract was prepared and its activity measured. The raw extract was autoclaved for 30 min. at 15 lb. pressure per sq. inch. The insects, 10-12 days old were fed the control diet and the same diet supplemented with the appropriate amounts of raw and autoclaved inhibitor extract and vitamin B₁₂ for about three weeks. At definite intervals, ten larvae were picked out at random and weighed. The growth rate values indicate that raw soyabean extract retards the growth of the insects which is reversed by the addition of vitamin B₁₂. Autoclaving the crude extract, however, destroys the toxic constituents present in it. It has also been shown that addition of vitamin B₁₂ alone to the basal diet does not produce any increase in the growth of the insects.

K.L.R.

DAIRY

Effect of feeding rancid ghee (clarified butter) to rats, by Saroj Tawde and Magar, N. G., *Indian J. Dairy Sci.*, 1957, **10** (2) 73.—With a view to assess the nutritive value of rancid ghee, the authors have studied the effect of feeding rancid ghee on the growth rates and development of rats, apart from the fact that it produces gross vitamin deficiencies. Weaning albino rats were fed a diet of 20 per cent fresh

or rancid (peroxide value 28) fat for a period of 8 weeks. Growth rates of the animals were recorded twice a week and the fat and protein metabolisms were followed up. It is found that the weights of rats fed on rancid fat diet are lower than those of fresh fat group. Results of metabolism experiments show that there is no difference between phospholipid and cholesterol contents of the liver and brain. No difference was either found in the blood total cholesterol and phospholipids values thus indicating that fat metabolism is normal in both the group of rats. The urinary nitrogen values are much higher in fresh fat group than in the rancid fat group while the fecal nitrogen values show a reverse trend. It is thus shown that the protein metabolism is not so efficient in rats fed rancid fat diet as in the fresh fat group. These changes in protein metabolism may cause interference with growth.

K.L.R.

FISH

The free α -amino-acid nitrogen content of the skeletal muscle of some marine fishes and invertebrates, by Velankar, N. K. and Govindan, T. K., *Curr. Sci.*, 1957, **26** (9), 285.—The AA report in this preliminary note, the values for the α -amino-acid nitrogen content of the aqueous extracts of the skeletal muscle in a number of marine fishes. The values were usually below 30 mg. N per 100 g. of wet muscle and they were far lower than those recorded for lobster muscle by earlier workers. The analysis of crab, prawn and squid muscle carried out by the AA showed a high level of amino N comparable to that reported for lobster. The difference in the α -amino nitrogen values in fishes and in lobster, crab, squid and prawns suggests significant differences in the chemical composition of their muscle. High levels of α -amino N seem to be characteristic of invertebrate muscle, while the figures for vertebrate muscle are low.

K.L.R.

The studies in the nutritive value of Bombay Fish, Part IV. In vitro Digestibility of fish proteins, by Valanju, N. N. and Sohoni, K., *Indian J. med. Res.*, 1957, **45** (1), 115.—The enzymatic hydrolysis of fish proteins was studied by the action of pepsin, trypsin and pepsin followed by trypsin. The percentage of soluble nitrogen varied from 21 to 28 per cent of the total nitrogen during 24 hours of hydrolysis. The study of α -amino nitrogen revealed that the greatest liberation was obtained with proteins of black pomphret. It was found that except the ghol protein, all fish proteins showed greater percentage liberation than casein. It was observed that there was no change in the values of soluble nitrogen and α -amino nitrogen, on autoclaving the samples of fish proteins, for one hour at 15-lb. pressure. The chromatographic study revealed that arginine, threonine, leucine, valine and lysine were liberated during the first hour of peptic digestion. Arginine, however, was liberated in greater amount. The amino acids liberated by pepsin were also liberated by trypsin.

The studies in the nutritive value of Bombay Fish, Part V. The digestibility and the biological value of fish proteins, by Valanju, N. N. and Sohoni, K., *Indian J. med. Res.*, 1957, **45** (1), 125.—The biological value of fish proteins is assessed by five different methods. The study of B. V. of fish proteins by the nitrogen balance method showed that these proteins possessed high biological values. A good parallelism is found between B. V. and the percentage of creatinine nitrogen in urine of rats fed different proteins. The raw growth method showed that proteins of ghol and mandeli possessed nearly the same biological values. The study of B. V. of fish proteins by the growth of larvae showed that proteins of ghol, Bombay duck, mandeli and black pomphret were of high nutritive value. Proteins of pomphret and casein showed lower and nearly the same biological

value. Rice-moth larvae can be suitably adopted as test animals for evaluating the nutritive quality of protein.

FRUIT AND VEGETABLE PRODUCTS

Preservation of natural colour in litchies under cold storage, by Mukerjee, P. K., *Sci. and Cult.*, 1957, 23 (2), 101.—The attractive rosy colour of litchi fruit is not retained even in cold storage for more than 48 hours. Packing the fruits in polyethylene bags and storing them at 45°F does maintain the colour for three weeks but due to condensation of moisture inside the bags leads to browning of the tubercle tips. The author has therefore tried with various types of packages like polyethylene bags with absorbent cotton and paper strips inside cloth and craft paper bags. The fruits were cold stored at 40°F. The physiological loss in weight, the change in total soluble sugars and acidity and the general conditions like the colour and appearance of the fruits were noted. The results show that physiological loss in weight was lowest (4.5-6.4 per cent) in the case of polyethylene packs while in the open basket, the loss in weight was highest (39.5 per cent) after four weeks. There was not much change in sugar content of fruits stored in polyethylene bags whereas in other packs, it showed an appreciable increase. It is also found that litchies packed in polyethylene bags with paper shavings and cotton inside retained their natural colour for four weeks while in other packings, the colour was retained for seven days only. The ideal conditions for keeping and preserving the natural colour of litchies would therefore be to pack them in polyethylene bags with absorbent cotton and paper shavings inside the bag and storing them at 40°F.

K.L.R.

MICROBIOLOGY

Effect of condiments on the control of *Aspergillus niger* in mango pickle, by Anand, J. C. and Johar D. S., *J. sci. industr. Res.*,

1957, 16A (8), 370.—The effect of different condiments on the growth of *Aspergillus niger* in mango pickle has been investigated. Most of the spices, except cinnamon and cloves, had little or no inhibitory effect on this mould. Common salt, although not effective itself, supplements the preservative effect of cinnamon and cloves.

Synthesis of fat by *Aspergillus nidulans*: Part I—Changes in the composition of *A. nidulans* fat with sugar concentration in the medium, by Jagjit Singh and Ishwar Dutt, *J. sci. industr. Res.*, 1957, 16C (8), 164.—The production of fat by *Aspergillus nidulans* in a synthetic medium containing inorganic salts and different amounts of sucrose (10-40 per cent) has been studied. The optimum sugar concentration for the maximum yield of mycelial mass and fat formation is 20 per cent, the fat produced at this concentration exhibited the greatest degree of saturation. The least amounts of fat and fat are formed in the medium containing 40 per cent sugar, the fat produced at this concentration contains the smallest proportion of saturated acids, while the amounts of oleic and linoleic acids are higher than at lower sugar concentrations.

Change in mineral composition of *Aspergillus niger* during biosynthesis of citric acid, by Raina, P. N. and Ramakrishnan, C. V., *Curr. Sci.*, 1957, 26 (9), 285.—During the biosynthesis of citric acid in *Aspergillus niger* grown in malt extract—yeast extract—glucose medium the ash content of the mat was found to be changing. The mat was analysed for ash and minerals like Ca, P, Mg and Fe at different stages of fermentation. The percentage values obtained have been graphically represented. It is found that ash, Mg and P contents decrease whereas Fe and Ca increase as the production of citric acid increases. Since earlier work has shown that Mg inhibits the activity of the condensing enzyme of *A. niger*, it might be possible that Fe and Ca influence the activity of the enzymes involved

in the production of citric acid. Further work on the effect of these minerals at different concentrations on the activity of the isolated enzyme has to be carried out to show whether the change in mineral contents of the mat has any significance in the biosynthesis of citric acid in *A. niger*.

K.L.R.

OILS AND FATS

Turbidity temperature: a significant figure for judging the purity of sesame oil, by Nataraja Sarma, P. S., and Balasubrahmanyam, G., *Curr. Sci.*, 1957, 26 (8), 468.—Arachis oil is used as an adulterant in sesame oil and it is extremely difficult to detect its presence even when present at 20 per cent level on the basis of present standards fixed for sesame oil. The turbidity temperature of sesame oil being 19-20°C and that of arachis oil 39-40°, it is possible to detect and also find out the extent of adulteration by making use of this property. The authors have determined the turbidity temperature of genuine sesame oil and also artificial mixtures containing 5, 10, 15 and 20 per cent of arachis oil. The iodine value and Butyrorefractometer reading were also determined. The results show that the iodine value as well as Butyrorefractometer reading of sesame oil-arachis oil mixtures fall within the range prescribed for sesame oil. The turbidity temperature, however, is considerably altered by adding even 5 per cent arachis oil. A figure over 21.0 definitely proves adulteration. The AA have suggested the inclusion of the turbidity temperature of 19.0-21.0 as one of the standards for sesame oil.

K.L.R.

STORAGE

The relation between loss in viability and seedborne microflora in rice, by Padmanabhan, S. Y., *Proc. Indian Aca. Sci.*, 1957, XLVI (3), 155.—The changes taking place on the population of fungi internally borne in rice seeds during storage over relative humidity levels of approximately 10, 25, 50, 75, 90, and 100 per cent were

studied. Over 10, 25, and 50 per cent relative humidity levels there was a decrease in moisture content, but there was no deterioration in germinability within the period studied.

During storage over relative humidity levels of 75, 90 and 100 per cent there was deterioration in germinability of seeds following increase in their moisture content.

No moulds could be isolated from the seeds stored over 75 and 90 per cent relative humidity even after they had lost their viability during the course of the tests. Moulds were, however, isolated from seeds which had lost their viability during the storage over 100 per cent R. H. level.

Deterioration in germinability

was followed by decrease and disappearance of the normal internally borne fungi and this was followed by colonisation of the rice grain by principally *penicillia* in the case of seeds stored over water (*i.e.*, over 100 per cent R.H.)

It is concluded that mould activity has no direct relation to the inactivation of embryo in rice seeds in storage under wet and humid conditions.

GENERAL

Adhesives from tamarind seed testa, by Narayanmurthi, D., Ramachandra Rao, P., and Rulia Ram, *J. Sci. industr. Res.*, 1957, **16B** (8), 377.—Reports by earlier workers had shown that tannin-bearing raw materials could be used

in the adhesive industry. Tannin extracts of the barks of mangrove and *Acacia mollissima* have been used in preparing adhesives for the plywood industry. The authors in this note report the possibility of using the tannins from the tamarind seed testa, which is abundantly and cheaply available for making adhesives. Free and alkaline extracts have been prepared from the tamarind seed testa and the solid extracts have been used for preparing adhesives. The adhesive formulation is also given. Glue adhesion test has been carried out with veneers of various species and the results indicate the possibility of utilizing the tamarind seed testa for the manufacture of adhesive.

K.L.R.

PART II (Foreign)

ANALYTICAL

Colorimetric determination of beta-aminopropionitrile in mature legume seeds, by Garbutt J. T. and Strong, G. M., *J. agric. Fd. Chem.*, 1957, **5** (5), 367.— β -Aminopropionitrile (B.A.P.N.), the toxic principle found in *lathyrus odoratus* seeds, when incorporated into the diet of different animal species, has been shown to produce marked changes in several tissues of the body. A rapid and convenient method for the determination of this substance in legume seeds has been developed on the basis of a reaction between β -aminopropionitrile and ninhydrin, which produces a green colour. Concentrations of β -aminopropionitrile, as low as 50 p.p.m. in the sample analysed, can be directly detected by this method. *L. latifolius*, *L. sylvestris*, and *L. splendens* have been reported to be toxic to rats, but showed no detectable β -aminopropionitrile by this method; therefore, toxic substances other than this are present in these seeds.

Determination of 2, 6-Di-tert-butyl-p-cresol in edible fats by ultraviolet spectrophotometry, by Phillips, M.A. and Hinkel, R. H., *J. agric. Fd. Chem.*, 1957, **5** (5), 379.—2, 6-Di-tert-butyl-p-cresol is

a very effective agent for inhibiting oxidation in organic substances, including edible fats. To maintain effective control over food processing operations and ensure adherence to governmental regulations, a quantitative method was developed for determining 20 to 200 p.p.m. (0.002 to 0.02 per cent) in lards in the presence of other allowable preservatives, including butylated hydroxyanisole, nordihydroguaiaric acid, propyl gallate, citric acid, monoisopropyl citrate, and phosphoric acid. The lard sample is dissolved in cyclohexane and percolated through a chromatographic column packed with 100-mesh silicic acid. By washing the column with successive portions of cyclohexane, 2,6-di-tert-butyl-p-cresol is selectively removed from the adsorbent and recovered in the column filtrates. The filtrates are subsequently analysed by ultraviolet spectrophotometry, and the amount is calculated from absorbance measurements made at a wavelength of 284 m μ . This procedure has been tested with synthetic formulations of commercial brand lards and a hydrogenated vegetable oil shortening containing this additive. Recoveries consistently better than 93 per cent can be obtained.

Quantitative determinations of amino-acids in undesalted hydrolysates by buffer filter-paper chromatography, by Baker B. E. and Khan, N. A., *J. Sci. Fa. Agric.*, 1957, **8** (4), 217.—The amino-acids of undesalted casein hydrolysates have been determined successfully by quantitative chromatography on buffered filter-paper. The technique proposed includes the use of five newly developed solvent systems.

The values for the amino-acid content of casein found by this technique were in agreement with the values reported in the literature. The co-efficients of variation for the determination of individual amino-acids ranged from 7.4 per cent for glycine to 1.3 per cent for arginine.

Quantitative determination of 0.5—5 μ g. of amino acid nitrogen on paper chromatograms and in solution, by Korenberg, H. L. and Patey, W. E., *Biochim. Biophys. Acta*, 1957, **25** (1), 189.—The existing methods for the quantitative determination of amino-acid nitrogen on paper chromatograms or in protein hydrolysates suffer from the main disadvantage *viz.*, the interference of ammonia present either in the solvent or in the atmosphere. Removal of am-

monia by the Fowden technique in the chromatographic analysis using acid-phenol solvents is incomplete and variable. The distillation procedures or the microdiffusion technique lead to great dilution of samples making subsequent analysis difficult. The present method developed by the AA is based on the preferential absorption of ammonia by the polysulphonic acid resin Dowex-50 at pH 5.0, thus eliminating its inference in the quantitative ninhydrin procedure. Microquantities such as 0.5 μ g. α -amino nitrogen can be determined with an accuracy of ± 5 per cent while quantities of 1.5–5 μ g. can be determined with accuracies of ± 2 per cent. The method is rapid and is applicable in the determination of amino acids even in presence of ammonium salts.

K.L.R.

BAKERY

The natural ageing of flour, by Bennett, R. and Coppock, J. B. M., *J. Sci. Fd. Agric.*, 1957, **8** (5), 261.—Since 1951 untreated and commercially treated flours of different extraction rates have been stored under temperate conditions for eight-month periods and periodically examined to ascertain the naturally occurring change in baking quality. Doughs were tested by physical methods and other data associated with flour testing obtained. An increase in flour water absorption required to make doughs of normal consistency was observed which in part can be explained by drying out of the flour on storage. A slight toughening in doughs prepared from the earlier untreated flour was evident and was associated with some improvement in bread quality upto storage periods of about 4 months. The change, however, was very much less than what has generally been supposed and in no case was it comparable in extent to the improvement in flour produced immediately by commercial gaseous and/or powder treatment. The slight natural toughening of the doughs from treated flour was in some cases detrimental to bread quality. No significant change in

the breadmaking properties of flour could be detected during the first few days after milling.

BIOCHEMISTRY AND NUTRITION

Antibiotic growth stimulation of rats fed raw soyabean oil meal, by Borchers, R., Abadi, D. M. and Weaver, J. M., *J. agric. Fd. Chem.*, 1957, **5** (5), 371.—The rate of gain of rats fed raw soyabean oil meal was 80 per cent, or less, of gains made by rats fed autoclaved meal. The addition of 0.1 per cent procaine penicillin plus 0.1 per cent streptomycin sulfate has resulted in approximately equal rates of gains by rats fed raw and autoclaved soyabean oil meal. These results open a new point of attack on understanding the growth inhibitory effects of raw soyabean oil meal and, possibly, on the problem of the growth stimulatory effects of antibiotics.

Influence of addition of certain amino acids and vitamin B₁₂ to proteins in enriched milled wheat flour on growth, protein efficiency and liver fat deposition, by Barnett Sure, *J. agric. Fd. Chem.*, 1957, **5** (5), 373.—The influence of addition of certain amino acids and vitamin B₁₂ to proteins in enriched milled wheat flour on growth, protein efficiency, and liver fat deposition was investigated. The proteins in milled wheat flour were fed to albino rats at an 8 per cent level for 10 weeks. The optimum gains in body weight and protein efficiency were secured by supplementation with 0.4 per cent L-lysine, 0.2 per cent DL-threonine, 0.4 per cent DL-methionine, and vitamin B₁₂.

Protein synthesis in rat pancreas, by Laird, A. N. and Barton, A. D., *Biochim. Biophys. Acta*, 1957, **25** (1), 56.—The intracellular distribution of amylase in rat pancreas has been studied by differential centrifugation of pancreas homogenates. Although the secretory granules showed high activity, at least half the amylase activity was recovered in the microsome and

supernatant fluid fractions. In the latter fractions, the proportion of the total enzyme activity and the concentration of amylase activity relative to protein-nitrogen showed consistent variations with changes in the secretory state of the gland. Apparently some of the amylase is associated with the endoplasmic reticulum in the living pancreas cell and during homogenization in 0.88 M sucrose the endoplasmic reticulum is broken into pieces resembling one another in composition but differing in size. During exposure to 0.25 M sucrose some dissociation of the components of this material takes place, but when such dissociation occurs the amylase protein is not preferentially associated with either the ribonucleoprotein granules or the lipoprotein reticulum of the microsome fraction.

Quality evaluation and chemical composition of soy sauce, by Onaga, D. M. *et al.*, *Food Res.*, 1957, **22**, 83.—Data on the chemical composition and organoleptic quality of some samples of California soy sauce are presented, compared and discussed. Salt, acidity and nitrogen content are important factors influencing flavour acceptance. Amino acids in soy sauce, as determined by two-dimensional paper chromatography are reported. A rapid ion-exchange method to remove salt from soy sauce for paper chromatographic studies is described. The importance of various chemical constituents to flavour is discussed.

J.S.P.

The amino-acid composition of some Pakistani pulses, by Khan, N. A. and Baker, B. E., *J. Sci. Fd. Agric.*, 1957, **8** (5), 301.—A sample of horsebean (*Vicia faba* L.) was analysed for its amino-acid contents, by chromatography on buffered filter paper. The results were in general agreement with those obtained by microbiological assay and already reported in the literature. The co-efficients of variation for the determination of different amino-acids ranged from 1.5 per cent to 8.5 per cent.

Eighteen amino-acids have been determined similarly in the whole grains of five species of pulses commonly grown in West Pakistan.

COFFEE

Nutritional evaluation of coffee including niacin bioassay, by Teply, L. J. and Prier, R. F., *J. agric. Fd. Chem.*, 1957, 5 (5), 375.—The presence of approximately 10 mg. of niacin in 100 grams of ordinary retail coffees, as measured microbiologically, was confirmed by rat assay. Niacin level is dependent on degree of roasting. Experimental dark roasts contained up to 43 mg. of niacin per 100 grams of coffee and equally high levels were found in some speciality coffees obtained on the open market. The niacin is readily extracted in the preparation of beverage. Appreciably, but rather low, levels of seven B vitamins, other than niacin, were present in coffee beverage. Moderate amounts of extractable calcium and iron and low levels of sodium and fluorine were found in roasted coffee.

FISH

The use of tetrazolium salts for assessing the quality of iced white fish, by Shewan, J. M. and Liston, J., *J. Sci. Fd. Agric.*, 1957, 8 (4), 222.—The use is described of the reagent 2-p-iodophenyl-5-phenyltetrazolium chloride in a colorimetric method of assessing the quality of iced fish. The results are compared with those obtained from organoleptic examination, viable bacterial counts and the contents of trimethylamine and volatile bases.

Volatile bases as quality indices of iced north sea cod, by Shewan, J. M. and Ehrenberg, A. S. C., *J. Sci. Fd. Agric.*, 1957, 8 (4), 227.—Chemical and sensory variables were measured at intervals during the spoilage of different catches of fish stored up to 22 days in ice. The relation between the chemical and sensory variables was examined and found to differ from catch to catch. It is shown that the volatile base content of fish

muscle is a less precise index of eating quality than was expected, although it has considerable value.

FRUIT AND VEGETABLE PRODUCTS

Relation between the solubilization of pectin and the fate of organic acids during maturation of apples, by Doesburg, J. J., *J. Sci. Fd. Agric.*, 1957, 8 (4), 206.—The amount, degree of esterification and molecular weight of pectins in apples have been investigated weekly during some months before and after harvest. The molecular weight of pectin has been found to be constant during that period and the molecular weights of insoluble and soluble pectin in ripe fruits are nearly equal. Hence, shortening of chains of pectin molecule may not take place during the ripening.

The correlation between changes in solubility of pectin and in the solubility of calcium, changes in the composition of the mixture of organic acids in fruits and some experimental evidence of a change of pH of the cell walls during that period, may be an indication that solubilization of pectin during ripening of fruits is caused by movement of calcium in the cell walls.

Experiments on the relation between behaviour of calcium and solubility and swelling of pectin in cell walls and in artificial pectin films are discussed.

S.R.

Studies on banana pseudostem starch production, yield, physico-chemical properties and uses, by Subrahmanyam, V., *et al.*, *J. Sci. Fd. Agric.*, 1957, 8 (5), 253.—The pseudostem of banana has been shown to be a good source of starch useful for industrial and edible purposes.

Starch content of the stems has been shown to vary and is influenced by the variety, locality, stage of growth, physiological state of the plant and climatic conditions and particularly by the moisture content of the stems. The desirability of screening varieties with a view to selecting consistent yielders has been emphasised.

The process evolved for the manufacture of banana pseudostem starch is outlined and the potentialities of this new source of starch has been discussed.

Sizing tests have shown that it compares well with other common starches and on account of the somewhat transparent nature of the pastes, it imparts better lustre to the finished product.

S.R.

Effect of baking and of pressure-cooking on the ascorbic, dehydroascorbic and diketogulonic acid contents of potatoes, by Leichsenring, J. M. *et al.*, *Food Res.*, 1957, 22, 44.—Effect of two methods of cooking and of refrigeration after cooking on the ascorbic, dehydroascorbic and diketogulonic acid contents of a number of varieties of potatoes have been investigated. Baking tests were conducted on 3 varieties while cooking in a pressure sauce-pan was tested on 2 varieties.

J.S.P.

The carotenoids of ruby red grapefruit, by Curl, A. L. and Bailey, G. F., *Food Res.*, 1957, 22, 63.—The carotenoids of ruby red grapefruit pulp and peel have been examined by countercurrent distribution followed by chromatography. The two principle pigments of the pulp were found to be lycopene and beta-carotene, accompanied by lesser amounts of phytofluene and zeta carotene. Phytoene was a major constituent of the pulp and was the leading constituent of the peel, followed by phytofluene.

Countercurrent distribution showed the presence of both monols and diols (plus polyols) in much smaller amounts than the hydrocarbons. On chromatography, these fractions from both pulp and peel were found to be rather complex, about 13 constituents being found in both pulp and peel carotenoids. Apparently most or all of the xanthophylls found in oranges and tangerines were present as minor constituents.

J.S.P.

Effects of ionizing radiations on plant tissues II. Softening of

different varieties of apples and carrots by gamma rays, by Boyle, J. P. *et al.*, *Food Res.*, 1957, 22, 89. —Results of studies on the effect of radiation of the flesh of seven varieties of apples and five varieties of carrots with suitable dosages of gamma rays. The firmness was measured by the load in pounds required to crush the cylinders. In the case of all tissues, a linear relationship was obtained between the percentage change in crushing load and the logarithm of the gamma radiation dosage employed in the experiments. The calculated threshold dosages (TD) defined as the minimum amount of radiation required to bring about a measurable softening, ranged from 4.2×10^3 r to 107×10^3 r for the apples and from 23.5×10^3 r to 178×10^3 r for the carrots.

J.S.P.

PESTICIDES

Effect of low dietary levels of parathion and systox on blood cholinesterase of dogs, by Frawley, J. P. and Fuyat, H. N., *J. agric. Fd. Chem.*, 1957, 5 (5), 346.—The subacute toxicity of two organic phosphate insecticides, parathion

and systox, has been investigated in dogs by measurement of plasma and erythrocyte cholinesterase changes. As little as 1 p.p.m. of parathion and 2 p.p.m. of systox in the diet causes significant plasma cholinesterase inhibition. Erythrocyte enzyme inhibition occurs with 2 p.p.m. of parathion and 5 p.p.m. of systox. When both insecticides are in the same diet, the effect on plasma cholinesterase is at least additive. A convenient method for determining these cholinesterase changes is described.

Chemical determination of perthane residues on agricultural crops, by Miles, J. R. W., *J. agric. Fd. Chem.*, 1957, 5 (5), 349.—An analytical method has been developed for the determination of perthane residues on agricultural crops. The method involves the extraction of perthane residues with chloroform, dehydrochlorination, and reaction of the dehydrochlorination products with concentrated sulfuric acid at room temperature. The characteristic peach colour obtained has a strong absorption maximum at 493 m μ . Perthane residues as low as 0.1

p.p.m. can be determined on asparagus and corn.

Determination of organic chlorides and residues from chlorinated pesticides by combustion analysis, by Hudy, J. A. and Dunn, C. L., *J. agric. Fd. Chem.*, 1957, 5 (5), 351.—Analysis for traces of residues from chlorinated pesticides by combustion methods offers many advantages over other decomposition methods which involve chemical reagents. Available microcombustion procedures sometimes lack sensitivity because of a limitation on the size of sample which can be burned. Therefore, a vertical, quartz-packed furnace was developed, which features the ability to burn liquid organic materials continuously at rates of 10 to 20 grams per hour. The chloride resulting from combustion is determined by amperometric titration with silver nitrate after absorption in alkaline solution. A sensitivity of 5% of chloride has been achieved upon application of the method to toxaphene (chlorinated camphene, 67 to 69 per cent chlorine) in a variety of materials, including animal fat and butterfat.

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THE RELATION BETWEEN THE URIC ACID CONTENT AND THE EXTENT OF KERNEL DAMAGE IN INSECT INFESTED GRAIN

By S. VENKAT RAO, R. N. NUGGEHALLI, S. V. PINGALE, M. SWAMINATHAN AND
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(Central Food Technological Research Institute, Mysore)

In a previous communication,¹ it has been shown that in insect infested Bengal gram, the uric acid content increased in general with the increase in kernel damage. The increase, however, was not proportional to the kernel damage in certain cases. In Bengal gram (*Cicer arietinum*) damaged by *Bruchus* sp. damaged kernels usually have 1-3 exit holes and in field bean (*Dolichos lab lab*) 1-6 holes, each hole representing development of one insect in the kernel. A relationship between the extent of damage as revealed by the number of insect exit holes and uric acid content therefore appeared more likely. Such a relationship, if possible, might also lead to a better evaluation of the insect damage in grains. The present communication relates to investigations on the relationship between the extent of damage and the uric acid content as experienced with Bengal gram and field bean.

Experimental

Samples (2 lb. lots) of Bengal gram and field bean were drawn from 25 different stores in Mysore. The samples were drawn after mixing the contents of the gunny bags thoroughly.

Two lots (100 g.) of each sample were taken after thorough mixing. The percentage of kernel damage was ascertained in both the lots and the values for the two lots were, in general, in good agreement. One lot was powdered and the total uric acid present was determined according to the method described earlier².

The second lot of 100 g. was further sorted out according to the number of holes present in the grains. The weight of each category of damaged grain was determined. The number of seeds present in these samples was also noted so that the total number of holes present in 100 g. lot of the sample could be calculated. The samples were carefully powdered and the uric acid present in them was determined as before². The results are presented in Tables I and II.

TABLE I. Relation between the kernel damage, number of insect exit holes and uric acid in infested Bengal gram (*Cicer arietinum*) and field bean (*Dolichos lab lab*)

| Sample | | | | Moisture % | Kernel damage by wt. % | Total number of holes present in 100 g. of the sample | Uric acid present (mg/100 g) |
|-------------|---|-----|-----|------------|------------------------|---|------------------------------|
| Bengal gram | A | ... | ... | 10.5 | 8.2 | 65 | 141 |
| | B | ... | ... | 10.5 | 18.7 | 198 | 374 |
| | C | ... | ... | 9.7 | 21.3 | 185 | 302 |
| | D | ... | ... | 9.8 | 23.4 | 245 | 320 |
| | E | ... | ... | 9.4 | 47.4 | 500 | 625 |
| Field bean | A | ... | ... | 11.5 | 9.3 | 45 | 90 |
| | B | ... | ... | 12.0 | 15.5 | 100 | 140 |
| | C | ... | ... | 12.0 | 32.4 | 287 | 290 |
| | D | ... | ... | 9.7 | 37.1 | 240 | 270 |
| | E | ... | ... | 10.5 | 54.8 | 437 | 380 |

Results and Discussion

From the data given in Table I, it will be seen that with the increase in the degree of infestation as revealed by the number of insect exit holes, there is a rise in the uric acid content of the

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TABLE II. *Uric acid content of Bengal gram and field bean infested to different degrees as revealed by number of insect exit holes present*

| Sample | | | | Kernel damage by wt. (%) | Classification of seeds according to kernel damage | Weight (g) | Number of seeds | Uric acid present (mg.) | Uric acid per 100 g (mg.) |
|-------------|---|-----|-----|--------------------------|---|---|--------------------------------------|---|--|
| Bengal gram | A | ... | ... | 8.2 (65 holes) | 1 Holed Undamaged | 8.2 91.8 | 65 779 | 60.0 70.0 | 730.0 76.3 |
| | B | ... | ... | 18.7 (198 holes) | Undamaged 1 Holed 2 Holed 3 Holed | 80.8 17.2 1.5 0.12 | 717 160 16 2 | 162.0 147.0 20.3 4.7 | 199.0 857.0 1382.0 3891.0 |
| | C | ... | ... | 21.3 (185 holes) | Undamaged 1 Holed 2 Holed | 78.7 21.0 0.27 | 671 179 3 | 103.0 165.0 6.5 | 131.0 786.0 2379.0 |
| | D | ... | ... | 23.4 (245 holes) | Undamaged 1 Holed | 76.6 23.4 | 610 245 | 110.0 221.0 | 144.0 942.0 |
| | E | ... | ... | 47.4 (500 holes) | Undamaged 1 Holed 2 Holed 3 Holed | 52.6 43.0 4.0 0.44 | 497 411 37 5 | 116.0 371.0 74.0 13.3 | 225.0 864.0 1849.0 3004.0 |
| Field bean | A | ... | ... | 9.3 (45 holes) | Undamaged 1 Holed | 90.7 9.3 | 460 45 | 60.0 27.5 | 60.2 296.0 |
| | B | ... | ... | 15.5 (100 holes) | Undamaged 1 Holed 2 Holed | 84.5 12.5 3.0 | 425 68 16 | 57.6 38.5 32.4 | 68.2 308.0 847.0 |
| | C | ... | ... | 32.4 (287 holes) | Undamaged 1 Holed 2 Holed 3 Holed 4 Holed 5 Holed 6 Holed | 67.6 19.4 7.6 3.0 1.2 0.9 0.2 | 316 93 41 16 7 6 1 | 71.0 50.6 51.7 40.8 15.0 25.2 6.4 | 105.0 260.0 677.0 914.0 1244.0 2725.0 3165.0 |
| | D | ... | ... | 37.1 (240 holes) | Undamaged 1 Holed 2 Holed 3 Holed 4 Holed | 62.9 28.7 6.7 1.4 0.32 | 321 139 36 7 2 | 107.0 78.0 39.4 15.2 5.7 | 170.0 272.0 589.0 1099.0 1803.0 |
| | E | ... | ... | 54.8 (437 holes) | Undamaged 1 Holed 2 Holed 3 Holed 4 Holed 5 Holed | 45.2 32.8 15.7 4.8 1.2 0.35 | 220 164 80 25 7 2 | 44.3 89.1 124.7 61.5 13.4 10.8 | 98.0 272.0 795.0 1272.0 1147.0 3130.0 |

Note: Clean insect-free lots did not contain any uric acid.

infested material. The data also indicate that the number of holes present in the sample is a better index of the damage suffered by the material than kernel damage, since damaged kernels may have one or more holes. This will be evident when we compare the Bengal gram samples B and C. Though the kernel damage increases

from 18.7 per cent to 21.3 per cent, the uric acid in the material does not correspondingly increase. This discrepancy can be explained if we correlate uric acid content with the number of insect-exit holes present in the samples. A similar explanation can be offered in the case of field bean samples C and D also.

Movement, feeding and breeding of the insects in the grain, contaminate it with insect excreta and render it unfit for human consumption. Visual indices take only the kernel damage into account and not the excreta present due to the movement of the adult in the grains. Uric acid which is a measure of the insect excreta present in the grain appears, therefore, to be a better index of the unhygienic conditions in the grain than kernel damage. The extension of this observation to other foodgrains is in progress.

The uric acid in 100 g. of the grain samples having varying numbers of insect exit holes is also given in Table II. With both Bengal gram and field bean samples, a regular increase in the uric acid content is observed with the increase in the number of holes in the samples. The uric acid content per 100 g. is found to differ appreciably in the two grains. Investigations (unpublished) on a number of insects infesting different grains, have also indicated that the quantity of uric acid deposited by any one insect may vary to some extent depending on the food material infested.

Further investigations are in progress to extend the above observations to samples infested under controlled conditions.

The moisture content of the samples ranged from 10-12 per cent. The microbial load of the

infested material was not determined in these experiments. Since the organisms like *Aerobacter aerogenes* are ubiquitous in distribution and are almost invariably found on the grains, it is possible a small part of the uric acid produced by insects is utilized by the micro-organisms. This point is being investigated with samples infested under controlled conditions.

Summary

Data regarding the kernel damage, number of insect exit holes and uric acid present in Bengal gram and field bean samples infested by *Bruchus* sp. have been presented. The results indicate that the uric acid content of the infested samples can be better correlated with the number of insect exit holes than with kernel damage. The uric acid present in 100 g. of the samples containing seeds with different numbers of holes has been determined. In both infested Bengal gram and field bean, the uric acid is found to increase with the number of holes.

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USE OF 2-3-5 TRIPHENYL TETRAZOLIUM CHLORIDE FOR ASSESSING THE QUALITY OF FISH

It has recently been suggested that the tetrazolium salts may be used to detect spoilage in fish.¹⁻³ However, in our previous communication⁴ it was reported that the species of fish, the pH of the reaction media, and the various incubation periods have a marked effect on the reduction of 2-3-5 triphenyl tetrazolium chloride (TPTZ). Further work has shown that for a particular group of fish the influence of these factors can be considerably reduced by employing optimum conditions for the reduction of tetrazolium chloride to formazan. The modified method has been successfully applied to assess the quality of non-fatty fresh water fish and that of shrimp. The results are compared with

those obtained from organoleptic examination, viable bacterial counts and the values of trimethylamine, total volatile bases and volatile reducing substances^{5,6}.

The method consists briefly of adding tissue suspension (5 g. blended with 30 ml. of distilled water) to a conical flask containing 0.5 ml. of 0.5% TPTZ and 5 ml. of phosphate buffer of neutral pH. After initial shaking of the contents of the flasks, the time taken for the appearance of distinct pink colour (equivalent to about 80 μ g formazan) at 38°C was recorded.

Shrimp received from the west coast and having pronounced odour, suggestive of spoilage, with a T.V.B. value of 33.0% mg and V.R.S. 40

(micro equivalent reduction per 5 ml. juice) reduced the dye within 20 minutes. The observations with different types of fresh water fish from Cauvery river showed that with *Cirrhinia fulungee* (Arja) fillets stored at 30°C for 12 hours having a sour odour with a T.V.B. value of 13.4 mg% reduced the dye within 45 minutes. *Barbus carnaticus* (Gende) fillets stored at 4°C for 5 days having a distinct off-odour, reduced the dye just within 30 minutes. The analytical values for such a sample were T.V.B. 17.7 mg%, V.R.S. 22.0 and a bacterial count of more than ten million per g. of muscle. In case of fish fillets with pronounced putrid odour the pink colour appeared within just a few minutes. Similar results have been obtained with *Wallago Attu* (cat fish), *Barbus Dubious* (Kooralu) and *Labeo* sp. (Machalu).

Particularly for the species of fresh water fish mentioned here, the tetrazolium test promises to be a better indicator than the estimation of the total volatile base (T.V.B.) values which were found to rise very slowly at different stages of spoilage. These results show that this simple and quick objective method can be used to measure the spoilage of the types of fish dealt with in this paper. The method may also be

applicable to some other species of fish. This method is particularly useful when there is a high bacterial load on the fish. This is in agreement with the findings of Shewan and Liston¹ who have reported use of filter paper strips impregnated with a highly active iodine compound of tetrazolium for assessing the quality of iced fish.

This method fails in the case of fish containing appreciable quantity of trimethylamine oxide which exerts a poisoning action on the oxidation-reduction potentials of fish.

The details of the work described herein will be reported shortly.

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REVIEW SECTION

PRESERVATION OF VEGETABLES BY SALTING*

Salting as a means of reserving food has been used for many centuries, and vegetables so prepared are known to be wholesome.

In general, the more salt that is added to vegetables the greater length of time it will be possible to keep them. The salting procedure also depends upon the kind of vegetables being salted. Some vegetables cannot undergo fermentation without injury; with others it makes no difference; while some are benefited by fermentation.

Materials and equipment needed

Containers: The best containers for salting purposes are stone crocks ranging in size from

one to fifty gallons. Wooden kegs holding five to fifty gallons are satisfactory if they are well co-opered and are thoroughly cleaned by steaming or scalding to remove any traces of the odor or flavour of foods which were packed in them. It is considered good practice to paraffin all wooden containers coming in contact with brined foods.

Salt: If many vegetables are to be salted, the salt should be purchased in 100 pound quantities. Any good grade of salt is suitable. It can either be a fine grained granulated salt, such as table salt, or a coarser grained salt, such as 'flake' salt, or even the still coarser salt known as 'rock' salt.

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The purity of the salt is more important than the size of the grains, but granulated salt is considered to be the best type to use for salting vegetables.

Clean white cloth: It is necessary to cover the tops of the containers with some kind of clean white cloth after the vegetables are packed into the containers and salted. For this purpose cheesecloth or muslin is satisfactory.

Weights: It is necessary to keep the vegetables submerged beneath the brine at all times, and clean, hard stones are preferable but clean bricks will do. Do not use cement blocks unless they are paraffined prior to use. The pressure necessary depends upon the area of the surface of the container. A 5-gallon container should have about a 10 pound weight. The amount of pressure to apply, or the size of the weight to add, can be judged by only one thing. This is to apply a large enough weight so that the salt will extract sufficient juice from the vegetables to completely cover them within 24 hours. If at the end of 24 hours, the brine does not cover the vegetables, add more weight. The vegetables must be covered with brine at all times, otherwise spoilage will occur.

Boards are needed to place over the cheesecloth or muslin to form a stiff cover for the weights, otherwise the vegetables will not be submerged evenly. The cover may be made in one solid piece, or be made of salts evenly spaced about 1 or 2 inches apart and fastened together with cleats. It can be made in one piece or cut into two pieces. If the cover is made in one piece, it will have to be made smaller so that it will pass through the smallest diameter at the top of the wooden keg or barrel. If it is made in two pieces, it can be made larger since each half can be put in separately. Almost any type of wood except yellow or pitch pine may be used for making the cover. Wood such as maple, oak, beech, poplar or white pine is suitable. The cover should be fastened together with wooden pegs. If nails are used, they should be paraffined to prevent corrosion due to the action of the salt and acids on them.

Paraffin or Parawax is necessary to seal the tops of the receptacles, after fermentation has ceased. This is necessary in order to prevent evaporation and the formation of scum on the surface of the brine.

Preparation of the vegetables

Measuring equipment should consist of kitchen scales or steelyards, or any form of scales with which to weigh the vegetables and salt. A quart or gallon liquid measure is needed for measuring the water for the brine.

1. All vegetables should be thoroughly washed before salting.

2. String beans may be salted whole, or may be cut into pieces about 2 inches long.

3. Green tomatoes, green cucumbers, beets, greens such as turnip, beet, spinach and the like should not be cut up but should be left whole.

4. Peas and green lima beans should be shelled and corn should be husked before salting.

5. A better flavoured product will result in the case of peas, green lima beans, green beans and corn if they are heated, prior to salting, in water to boiling and held for 3 minutes. It is not necessary to heat, except to improve the flavour, of any of the vegetables except corn. If whole kernel corn is not heated to coagulate it, some of the material will be lost in salting. To salt ears of corn, husk and remove silk and place in brine.

Different methods of salting

There are several methods of salting which may be used, depending upon the vegetable and the length of time the vegetables are to be held before using. These different methods can be divided into two general classes, the dry salt and the brine methods. These in turn may be subdivided still further into the dry salt method with and without fermentation, and the brine method with and without fermentation.

(i) Dry salt method with fermentation: Vegetables to be preserved by the use of dry salt should first be thoroughly washed and drained of excess water. The amount of salt used depends upon whether they are to be fermented. No water should be added to the vegetables unless the salt does not extract sufficient water from the vegetables to form enough brine to cover them. If such is the case, make sufficient brine to cover them by adding one pound of salt per gallon of water.

1. Wash vegetables to free them of dirt and sand, and drain off excess water.

2. Weigh vegetables and record weight.

3. Two and one-half to five per cent by weight of salt is used in this method. For $2\frac{1}{2}$ per cent use $2\frac{1}{2}$ pounds of salt for every $97\frac{1}{2}$ pounds of vegetables, and for 5 per cent use 5 pounds of salt for every 95 pounds of vegetables. For larger or smaller quantities of vegetables use proportionate amounts.

4. Place about one inch of the vegetable in the bottom of the receptacle and sprinkle a little salt over the surface. Add another layer of the vegetable and add some more salt. Do not add too much salt with each layer or the first layers will receive all the salt. Try to distribute the salt so that each layer will receive a small amount. It is better to have some salt left at the end than to have used it all before reaching the last layer. If some salt is left it can be added to the last layer of vegetables and will diffuse throughout the entire mass, while if all the salt is added to the first few layers, it will require some time for the salt to reach the upper layers. In the meantime the top layers of vegetables may spoil.

5. It may not be possible to fill the container entirely full of vegetables at one salting. If such is the case, treat the partially filled container as described in step 6.

6. Between each salting, or when the container has been completely filled, the vegetables should be covered with two or three layers of clean cheesecloth or muslin. On top of this layer of cloth should be placed the wooden cover. This in turn should be weighted with a clean stone or bricks.

7. Fermentation, indicated by bubbles arising to the surface, should start within 24 to 48 hours, depending upon the temperature. Vegetables salted in warm weather should be completely fermented in a week or ten days. Those salted in cool weather will require from two to four weeks or longer. To determine when active fermentation has ceased, tap or kick the sides of the container gently; if no bubbles arise, fermentation is completed.

8. Prepare for storage according to the directions given at the end of this article.

Certain kinds of vegetables can be dry salted with a low percentage of salt while others cannot, since they will spoil or have an undesirable flavour. Leafy vegetables such as spinach, chard and cabbage, as well as greens such as beet, mustard

and turnip may all be preserved by a small percentage of salt added dry. The subsequent fermentation which they undergo after a light application of salt seems to enhance their flavour. Their keeping qualities is usually limited from fall until the following spring.

(ii) *Dry salt method without fermentation*

The heavy dry salt method is preferred by some to the heavy brine method. Greater care is necessary in distributing the salt throughout the vegetables when they are being put down. This method has the advantage of being very simple and easy to carry out.

1. Wash the vegetables, drain off excess water and weigh.

2. Weigh 18 to 25 pounds of salt for each 100 pounds of vegetables. For smaller or larger quantities use the same proportion of salt.

3. Place a layer of vegetables about one inch thick in the bottom of a clean container. Sprinkle salt over them. Add another layer of vegetables with more salt. Continue until the container is full or until the vegetables at hand are salted. The salt should be equally distributed so that the quantity of salt will be sufficient. Do not sprinkle too much salt on the first layers of vegetables or there will not be enough for the last layers.

4. At the end of each salting or when the container is filled to within about 3 inches of the top, cover with 2 or 3 layers of clean cheesecloth or muslin, place on wooden cover and weight down with suitable weight.

5. After 24 hours, if the salt and the pressure of the weight has not extracted sufficient brine to cover the vegetables, make enough brine to cover them by dissolving one pound of salt in two quarts of water.

6. Bubbles will rise from the salted vegetables at the start but will not continue long. It is not due to fermentation but to the forcing of air and gases out of the vegetables by the strong brine.

7. As soon as the bubbling ceases prepare the vegetables for storage as described at the end of this article.

(iii) *Weak brine method of salting—with fermentation*: Some vegetables do not contain sufficient water to make their own brine when salt is added to them so they are best salted in a brine. Such vegetables are cucumbers, string beans, green tomatoes, beets, beet and turnip greens,

nd corn. The salting and subsequent fermentation which takes place in the brine does not appear to harm the flavour of these products to the extent that it does in other vegetable products.

1. Wash vegetables to remove all dirt and sand and drain off excess water.

2. Weigh and pack them in a suitable container. Fill the container within 3 inches of the top.

3. Prepare a weak brine as follows: To each gallon of water add one pound of salt and one-half pint of 4 per cent vinegar.

The amount of brine necessary to cover the vegetables depends largely on the vegetables. It ranges from one-half the volume, that is, 1 to 1 (50-50) to 1 to 3. For example, in a 5-gallon container there would be half brine ($2\frac{1}{2}$ gallons) and half vegetables ($2\frac{1}{2}$ gallons) on the 1 to 1 ratio, and on the 1 to 3 ratio there would be about 1.5 gallons of brine and 3.5 gallons of vegetables.

4. A clean container should be used for making the brine. Sufficient brine should be made at one time to last for one day. If any brine is left at the end of the day, it is best to throw it away and make fresh.

(iv) *Heavy brine method with fermentation:* It is necessary and desirable to use more salt for certain vegetables—such as corn, cucumbers and green beans—especially if they are to be kept for any length of time. These vegetables may be put down in a certain salt concentration which will permit fermentation at the start but which will gradually cease as the salt concentration is increased. The increased amount of salt will, at the same time, insure the preservation of the vegetables.

1. Wash vegetables and drain off excess water.

2. Weigh vegetables and place them in a suitable clean container within 3 inches of the top.

3. Cover them with two or three layers of clean cheesecloth or muslin. Place a board on top of the cheesecloth and weight down with a stone or other suitable weight as previously described.

4. Make a brine according to the following formula: 1 gallon of water and 1.0 pound of salt.

5. Cover the vegetables with this brine, and

for every ten pounds of vegetables sprinkle one pound of salt over the top of the brined vegetables. This is necessary to compensate for the water in the vegetables.

6. Fermentation should start within 24 to 48 hours. Allow to ferment one week.

7. At the end of a week add dry salt at the rate of one half pound for each 100 pounds of vegetables. This salt may be added by simply sprinkling it over the surface of the container. It will dissolve and diffuse throughout the container.

8. Continue to add the dry salt at this same rate for a period of at least 10 weeks. By this time the vegetables should be completely fermented and cured, and ready to store according to directions at the end of this article.

(v) *Heavy brine method without fermentation:* Experimental work on salting vegetables has demonstrated that peas, both Alaskan and sweet, and green lima beans, could not be salted successfully at a salt concentration that permitted any fermentation, and only the heavy brine method, in which no fermentation takes place, is recommended for peas and green lima beans.

There are vegetables other than peas and green lima beans, such as onions, and cauliflower, that cannot undergo fermentation because of softening. For this reason it is necessary to salt these vegetables in a brine containing so much salt that few or no organisms can grow. The few that do grow will not cause any noticeable changes.

1. Wash vegetables and drain off excess water.

2. Weigh and place them in a clean container. Cover with two or three layers of clean cheesecloth or muslin and place board on the top of the cloth. Weight down with suitable clean weights as previously explained.

3. Cover with a strong brine made as follows: 1 gallon of water and $4-4\frac{1}{2}$ pounds of salt. This amount of salt will not go into solution in a gallon of water; so stir the salt and water vigorously and add the brine and undissolved salt to the vegetables. The excess salt will be eventually dissolved by the water in the vegetables.

4. Cover vegetables with brine of this strength until brine comes above wooden cover. No fermentation should take place since the brine contains sufficient salt to kill or check the growth of all organisms except the yeasts which produce

scum. However, scum formation will take place very slowly.

Storage of salted vegetables

The storage of salted vegetables presents no great problem. However, certain precautions are necessary. The great enemy of salted foods is scum which is made up of microorganisms called yeasts. These yeasts are harmless if eaten, so their presence would be all right if they did not eat up the acid which the bacteria produced. The best method of preventing the growth of scum is to keep the air away from the surface of the brine.

(i) The first and easiest method is to cover the surface of all the brined vegetables with hot paraffin. The paraffin should be sufficiently hot to make the brine boil when poured on top of it. It should be spread around the edges of the container so as to seal them air tight, just as is done in sealing a glass of jelly with paraffin to keep out mold. Place containers where they will not be disturbed before paraffining. If for any reason the seal is broken, melt some paraffin and close the broken place, or remelt all the paraffin and make a new seal. Do not seal the containers until all fermentation has ceased. If scum collects before fermentation ceases, skim it off every day. Be sure the brined vegetables are free of scum before sealing them.

(ii) A second method is to remove the heads from clean kegs or barrels and pack them full of vegetables and brine. Place the head back in the keg, bore a half-inch hole in the head and completely fill the keg with brine. Place in storage. Check the kegs or barrels occasionally for leaks and see if they are completely full of brine. Keep them full at all times with brine

made by adding 1 pound of salt to 1 gallon of water. Any size glass jars or jugs are ideal for storage. Vegetables may be repacked from large containers into smaller containers such as quart jars. The jars should be filled full of vegetables and the brine poured over them until full, then sealed with a rubber cap or with paraffin.

(iii) A third method is to cover the surface of the salted vegetables with an oil such as cottonseed or neutral mineral oil. It should be placed over the top about an inch or more thick. It should be drained or siphoned off before using the vegetables. This method is not recommended unless the other methods cannot be used.

(iv) A fourth method which is preferable to any so far described, but which is only applicable to the heavy brine or heavy dry salt methods, is to allow the salt to crystallize at the surface of the liquid. After the vegetables have been recovered with heavy salt brine several times because of evaporation, the salt will crystallize and form a solid crystalline layer over the entire surface of the container. This effectively seals and prevents any further development of scum.

It is best to store the salted vegetables at temperatures around 50 degrees F. However, vegetables salted according to the heavy dry salt or brine methods can withstand very hot or cold temperatures. Light dry salted or brined vegetables cannot stand very hot temperatures over a long period without spoiling, or very cold temperatures without freezing.

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TECHNICAL AID TO FOOD INDUSTRIES (published in July 1954), pp. xvi + 270.

This publication contains the views and suggestions of prominent scientists, leading industrialists and food technologists, and Government officials on the nature of technical aid needed by different food industries in the country. Up-to-date technical and statistical data are provided and an appendix embodying the conclusions of the Symposium as well as a comprehensive index are given.

Price: Indian = Rs. 5.00 (postage extra); Foreign = 10 shillings.

Technical Seminars

(Convener: H. C. SRIVASTAVA)

The Seminar is a weekly feature of the scientific activity of the Central Food Technological Research Institute, Mysore, and is held every Saturday. One of the scientific workers in the Institute presents a paper on a problem on which he is engaged, or reviews one of the aspects of food technology. The Seminar provides an open forum for all workers to express their views on the subject-matter of the paper. Summaries of the Seminars held during November 1957 are given below:

S (IS) 215 (162)

Use of 2-3-5 triphenyl tetrazolium chloride for assessing the quality of fish, by Moorjani, M. N. (November 9, 1957) Widely varying methods have been proposed and employed for assessing the quality of fish but none of the hitherto recommended methods has proven of general applicability and usefulness.

Attempts were therefore made to use a highly electropositive dye 2-3-5 triphenyl tetrazolium chloride for determining the quality of raw fish stored at various temperatures.

To start with, the reduction of tetrazolium was studied in relation to species of fish, the pH of the reaction media and the various incubation periods. The procedure consists in adding a uniform representative sample of juice pressed from the muscle to sterile test tubes containing phosphate buffer of specified pH and the aqueous solution of tetrazolium chloride. After shaking, the tubes are immersed in a thermostat at 38°C protected from direct sunlight and at suitable intervals the formazan formed was colorimetrically estimated. This study shows that the reduction of tetrazolium to formazan is not specific to a particular pH, it changes with the species of fish for a given incubation period. The probable explanation is that a large number of micro-organisms with different bacterial activities are involved in spoilage of fish. The species of fish should be taken into consideration while applying the time factor of the tetrazolium reduction test for judging the quality of fish.

These findings were confirmed by applying the tetrazolium method

to assess the freshness of marine and fresh water fish representing various grades of quality. The results were compared with those obtained from organoleptic examination, viable bacterial counts and the contents of trimethyl amine, volatile bases and volatile reducing substances. It was observed that the staler the fish, the quicker was the formation and greater was the amount of formazan produced. With certain species of spoilt fish the distinct colour of formazan appeared after some hours even though the amount of substrate was appreciably increased. The viable bacterial colonies cultured on nutrient agar containing tetrazolium salt, exhibited a marked differentiation in red pigmentation possibly due to variation of their dehydrogenase bacterial activity.

Among the species of fish studied the modified tetrazolium method has been successfully supplied to measure the extent of spoilage of shrimp. The method is quite sensitive and the results can be very closely correlated with organoleptic evaluations. It is simple from practical point of view enabling rapid determinations of the raw material. Even filter paper strip impregnated with an aqueous solution of 2-3-5 triphenyl tetrazolium chloride and dried in an incubator at 37° C, can be conveniently used to assess the quality of peeled shrimp just within a few minutes. The effect of size of fish, season and the kinds of bacteria in the environment at a particular time are being taken into consideration.

During the discussion that followed various points were raised e.g. applicability of the method to fatty fish, the mechanisation of the

test, efficacy of tetrazolium salts over other redox indicators, the nature of bacterial flora during the spoilage of fish, the food poisoning caused by fish and fish products, and the inclusion of reducing sugars in the media to stimulate the reduction of the dye to formazan.

Concluding, the President emphasized the need of some quicker way to assess the spoilage in other species of fresh fish other than shrimps. He suggested the use of some other chemical tests, where some component can be quickly assessed and which may be done instantaneously at the time of purchase.

S (IS) 216 (163)

A 'Prophylactic' process for pest control, by S. K. Majumder, (November 23, 1957). Preferential absorption of Lindane in emulsion by B-twill jute fabric presented a serious problem for progressive dipping of bags in batches in an emulsion for large-scale impregnation of jute bags with Lindane. Experiments undertaken to reduce the preferential absorption of insecticides by the jute bags from emulsion were described. Screening of solvents for Lindane and Dieldrin water dispersible emulsion concentrates revealed that acetone, toluene, xylene, benzene and Aromex (a highly aromatic light petroleum distillate) were the prospective carriers for the pesticides. Butylalcohol tended to increase the solubility of insecticides in solvents like Aromex, kerosene, petrol and batching oil. Compatibility of the solvents with emulsifiers such as Turkey red oil, Lissapol, Teepol and Tween 80, was examined for stability of oil-

in-water type emulsion. Four combinations of solvent-oil-emulsifier systems which answered to the requirements with regard to emulsion characters were subjected to Progressive Dipping Test with B-twill fabric. Although by varying the phase-volume ratio and solvent systems the degree of preferential absorption of emulsions by the fabrics could be narrowed down considerably, the proportionate reduction in the sizes of Lindane and Dieldrin crystals on the fabric reduced the residual effects at the same time. It was further indicated that the formulation which gave least difference in the insecticide contents between the first and last test pieces in progressive dipping experiment, the insecticidal activity was minimum in comparison to others. The ranges of crystal sizes for Lindane and Dieldrin were found to be $1.6-8\mu$ (rhomboidal) and $0.26-0.4\mu \times 2.4-2.8\mu$ (prismatic) respectively as the optima for the residual and residual effects of the impregnants. The studies on impregnation of jute bags with insecticidal emulsion were extended to fabrics other than B-twills. It was observed that at $77-80^\circ\text{F}$ the emulsion uptake by different sacking and other jute fabrics varied between 1.48 to 1.6 ml/gramme of fabric material. Since the weights of various sacking materials varied considerably and as much as 70 g. to 30 g/sq. ft., to ensure adequate levels of insecticides (Dieldrin and Lindane) in the various types of gunny bags the maximum dilution limits for the emulsion concentrate for impregnation of each type of sacking material was standardized. It was reported that 6.3 ml of

concentrate was to be diluted to 1900—1500 ml. for B-twills and 810 ml. for gunny packing (43.1 ml/sq. ft.—emulsion uptake). Optimum exposure period with the impregnated fabrics for *Tribolium castaneum* adults for effective control of infestation, with relation to the penetrability of the insect through various types of jute sacking materials was reported to be 15 to 30 minutes.

Shri Majumder further described the technique of insecticidal impregnation of jute bags *in situ* in grain stores. He said that at the suggestion of the Director experiments on impregnation of jute bags by spraying to avoid the preferential absorption of insecticide from emulsion were undertaken. But preliminary experiments showed that although the preferential absorption of the insecticide from emulsion could be avoided by spraying, the droplet size of the spray being very minute and also due to rapid volatilization of the solvents micro-crystals of Dieldrin and Lindane tended to be liberated from the droplets of all the formulations (Impregmol series) having low viscosities. Consequent to the minute droplet size ($4-0.1\mu$ and below) of the spray, and liberation of insecticidal crystals even before impingement on the fabric surface, the residual effects of the impregnation could not be maintained beyond 3–5 months even with an initial level of 35–50 mg. of insecticides per square foot. Therefore, the problem was investigated from a fundamental angle of producing the optimum droplet size having good wetting power and capillary spread to achieve maxi-

mum residual activity, widest insecticidal spectrum, and least contamination hazards to foodstuffs. Under standard conditions of spraying with 30 lb./sq. in. pressure and a 0.5 mm. nozzle orifice, droplets ranging from $0.8-18\mu$ were obtained with the new formulation. Under similar conditions droplet range of $3.5-0.2\mu$ and below was obtained from Impregmol. Liberated crystals of Lindane and Dieldrin of sub-microscopic sizes were deposited on the test fabrics and level of contamination through the fabrics was found to be of a higher magnitude in Impregmol series than that of the formulation mentioned above. Investigations on the magnitudes of contamination of grains through web clearance of different jute sacking fabrics revealed that B-twill fabrics do not present any possibility of contamination hazards by impregnating the bags with grains *in situ* by spraying with the formulation. It was further observed that the various sacking fabrics used for bags in grain stores did not have a web clearance exceeding 26 per cent. Under those conditions a contamination of the order of 3 p.p.m. of Lindane in peripheral bags of the stack was estimated.

The talk was followed by a short discussion and the President in his remarks pointed out that the commercial trials should be undertaken at various centres in India where the extreme and optimum climatic conditions will influence the residual effects of the treatments, so as to standardize the process for commercial conditions.

BROCHURE ON HOME-SCALE FOOD PREPARATIONS SERIES

This brochure contains 66 leaflets on the preparation and preservation of fruit, vegetable and other food products. It is divided into two parts, *viz.*, the 'Home-scale Fruit and Vegetable Preparations Series' giving recipes for the preparation of 55 fruit and vegetable products together with a list of the equipment required for their cottage-scale preparation; 'Indian Sweet Series' giving methods of preparation and preservation of 3 kinds of typical Indian sweets; and the 'Substitute Foods Series' giving in detail the methods of preparation of 8 substitute foods and food products.

Price: Re 1.00 (postage extra)

Information and Advice

IN pursuance of the policy of rendering technical aid to food industries in the country, the Central Food Technological Research Institute, Mysore, supplies information on technical and other problems, carries out analytical work and undertakes short- and long-term investigations on behalf of the industry, besides bringing out publications containing important technical advances in English and other modern European languages. The Institute receives a number of enquiries from various food industries and others interested in Indian processed food products. From the enquiries received a few are culled out and reproduced, together with replies, in this section.

Packing of walnut kernels

E (IS) 15968 (395)

We would like to know the method that you have developed to pack walnut kernels in order to make it safe from infestation during sea voyage and storage. (Jammu.)

As a result of the work done in this Institute, a method has been developed to control the infestation generally observed in walnuts during storage and during their transport by sea. The walnuts are put in 300 gauge polyethylene bags and the bags are sealed. They are placed inside specially made wooden cases and then fumigated by using methyl bromide at the rate of 2 to 2½ lb./1000 c. ft. for either 3 hours under a vacuum of 25" of mercury or for 24 hours at atmospheric pressure. Complete mortality of the insects will be observed. After fumigation, the wooden cases are closed with the lids. The outside of the cases is painted with an insecticidal formulation in order to prevent the entry of any external infestation into the boxes. This process can be applied in commerce with great advantage.

Refining and deodorization of edible oils

E (IS) 14758 (396)

Would you please write to me in detail the method of refining and deodorizing edible oils? (N. Arcot District).

The impurities generally present in oils are free fatty acids, proteins, phosphatides, gummy or mucilaginous materials, colouring matter etc. Refining and bleaching are done to remove all these impurities. The refined and bleached oil is further subjected to deodorization to remove traces of constituents responsible for flavour and odours.

Refining can be carried out by adopting any of the methods in vogue viz. alkali refining, acid refining, refining by liquid extraction, steam refining etc., but by far the most important and generally practiced method of refining oils meant for edible use is by treatment of the crude oil with an alkali. Alkali refining ensures an almost complete removal of free fatty acids, which are converted into oil-insoluble soaps. Other acidic impurities also combine with alkali and there is some removal of impurities from the oil by absorption on the soap formed in the operation. Besides, all substances which upon hydration, become insoluble are removed.

Refining by caustic soda can be carried out by the batch method or the continuous method. The latter has a double advantage of greatly reducing the time of contact between oil and alkali, and effecting a very efficient separation of soap-stocks (refining foots). The continuous refining process is as follows:

Crude oil from a feed tank is pumped continuously into a motor-driven mixer chamber where it is treated with the calculated amount of caustic soda solution. The mixture of the two is passed into a low-pressure steam heater, where a break is obtained by raising the temperature to 140-160°F. It is then made to flow into a battery of super-centrifuges where the oil is separated from the soap stock (impurities in the form of soap). The entire time between introduction of the lye and separation of soap stock is only about 3 minutes.

The oil is washed with 10-20 per cent hot water and centrifuged. The washed oil is dried in a vacuum dryer.

Bleaching: The resulting oil is heated to 220°F and 2-6 per cent of fuller's earth is added as the absorbent. From 0.5 to 1 per cent activated carbon is also added. The mixture is agitated well and filtered through filter presses.

Deodorisation: The bleached oil is then deodorised by distilling off the odoriferous impurities from the oil under diminished pressure with the aid of superheated steam.

Manufacture of Annatto colour

E (IS) 15966 (397)

We shall be highly obliged if you can kindly furnish us the literature on the method of manufacture of annatto butter colour. Where are the Annatto seeds grown in our country? (Amritsar).

Annatto is a fruit of a shrub called *Bixa Orellana*. The principle colouring matter in this is bixin. The fruit is the source of the orange-red dye 'Annatto'. The method of extracting the colouring principle from the seed is as follows:

Annatto seeds are boiled in neutral oil for several hours. During the latter period of the process the temperature is raised to about 240°F for the purpose of effecting a permanent solution of the colouring principle in the oil. The mixture is then filtered through a heavy canvas either by gravity or under pressure. The filtered oil constitutes the butter colour of commerce. It is perfectly clear to the eye but under magnification, shows the presence of very fine particles of suspended matter. Low temperature or abrupt changes in the temperature, exposure to air, and agitation tend to accelerate the precipitation of butter colour. The containers should, therefore, be

stored in a place where the temperature is fairly uniform, preferably at room temperature, and the contents should be protected against excessive agitation and exposure to air.

Annatto is grown in Central America, Brazil, Guiana and Mexico. In India it is cultivated on a very small scale in Mysore. It has also been reported to be found in Travancore, Coromandal and Malabar Coasts and in certain districts of Bombay, Bengal and Assam.

The bulk of Annatto used in the dairy industry in India is imported from U.S.A.

Preparation of grape fruit squash

E (IS) 12033 (398)

Let me know the method of preparing squash from grape fruits so as to enable me to keep it for at least a year without any fermentation taking place. What would be the cost of a bottle of grape juice? (Madras).

Generally squash is not prepared from grapes but only syrup and juice are prepared. However, we are giving below the method for the preparation of grape squash. Fresh and sound grapes are selected and washed with water. The grapes are crushed as such and the juice extracted by putting them in thick cloth and pressing the same in a small Screw type Basket-Press. The resulting juice is mixed with sugar, water and citric acid according to the recipes given below:

| | Recipe No. I | Recipe No. II | Recipe No. III |
|---|-----------------|------------------|-------------------|
| (i) Juice ... | 4 lb. | 4 lb. | 2 lb. |
| (ii) Sugar ... | 5 lb. | 3 lb. | 2 lb. |
| (iii) Water ... | 3 lb. | ... | ... |
| (iv) Lime, lemon or citric acid (ac- cording to taste) ... | 3 oz. | 1½ oz. | ... |

The ingredients are mixed well and strained through a coarse muslin cloth. Sodium benzoate is added as the preservative at the rate of 1000 parts per million. The finished product is poured in clean sterilized bottles leaving a head-space of about 1 to 1½ inches. It is then corked and stored in a cool dry place.

The cost of grape juice depends on the availability of grapes and its price. We have not worked out its cost in our Institute. It can be easily calculated by adding the processing cost to the price of grapes.

Manufacture of glucose from corn starch

E (IS) 12857 (399)

I would highly appreciate if you can send me all the particulars regarding the preparation of glucose from corn starch. (Nellore).

Glucose can be prepared from corn or any other cereal or tuber starch according to the method given below:

Corn starch is suspended in water and this suspension is treated with 0.25—5 per cent hydrochloric acid (by weight of starch) in a converter. Steam is passed into the converter and pressure of about 40 lb. per inch is maintained until about 90-91 per cent conversion to glucose has been attained. The acid solution is then transferred into tubs and neutralised to a pH of 4.8 with sodium carbonate. Fatty materials originating from the starch are separated by centrifuging and protein and insoluble carbohydrates are removed by filtration. The filtrate is now decolourised and purified by passing through animal charcoal and after evaporation to approximately 30° Be (about 55

per cent by weight) is filtered through animal charcoal. The final filtrate is then evaporated in a vacuum pan to give glucose crystals.

Bleaching of walnuts

E (IS) 5968 (400)

Kindly suggest us the latest and improved methods of bleaching walnuts in shell. (Jammu).

Bleaching of walnuts only imparts a light brown colour to the nuts, valuable from the selling point of view. At one time, this was done by fumigation with burning sulphur but nowadays momentary immersion in a bleaching solution is preferred. The bleach solution consists of bleaching powder and sodium carbonate. The aqueous mixture of these is allowed to settle to get a clear solution so that formation of a white film of the lime is avoided. The nuts after drying, are left in contact with the clear, bleach solution for not more than three minutes. They are dried in the shade without rinsing. Cracked and split nuts should not be bleached.

Conditioning of wheat

E (IS) 16332 (401)

May I know as to what is meant by the word 'conditioning' of wheat? (Agra).

Conditioning of wheat is one of the stages in the manufacture of wheat germ. It consists in the application of heat, water and air to wheat for a definite length of time in such a way as to facilitate the best separation of the bran from the endosperm and as far as possible to improve the packing value of the resulting flour.

Notes and News

STATISTICAL NOTES

Food Production Statistics for August, 1957

| Name of Industry | No. of Units | Production during August, 1957 |
|-----------------------------------|--------------|--------------------------------|
| Confectionery | 24 | 601 tons |
| Biscuits | 21 | 1,086 " |
| Flour milling | 26 | 42,907 " |
| Butter (tinned) | 3 | 41 " |
| Cashewnuts | 8 | 904 " |
| Dal and gram flour | 1 | 256 " |
| Aerated water | 29 | 48,900 gross bottles |
| Beer | 2 | 128,027 bulk gallons |
| Country spirit | 22 | 345,658 " " |
| Indian made foreign liquor | 15 | 42,600 " " |

(Ministry of Commerce and Industry, Government of India)

BOOK REVIEW

The Freezing Preservation of Foods, by TRESSLER AND EVERS, Published by Avi Publishing Co., Inc., New York, Completely revised and augmented edition, Vol. I.

The authors have fulfilled the need for a modern comprehensive treatise on frozen foods for the benefit of the fast developing frozen food industry as well as for the students and workers in the field of Food Technology, since 1943 when they brought out the first edition of their book 'The Freezing Preservation of Fruits, Fruit Juices and Vegetables'. Since then, there have been tremendous technological advances in the field and the need for the revision of the book had arisen from time to time. The latest edition published this year has been brought up-to-date with all the modern technological development and fulfils the need of the day. It brings under one cover all the practical scientific information needed for the plant operator as well as for the reference work. Addition of new chapters on fruit varieties for freezing, fruit juice concentration by freezing—freeze-drying and expansion of important types such as plant sanitation, transportation of frozen fruits, ware-housing of frozen foods have enhanced the practical value of the book.

This comprehensive book prepared in collaboration with various leading authorities in the field of frozen foods in the U.S.A. is a MUST for every branch of the frozen food industry as well as for ready reference in a technological, educational and research institution.

H. A. B. PARPIA

I.S.I. CERTIFICATION MARK FOR D.D.T. FORMULATIONS

The Indian Standards Institution has granted a licence to Messrs. Geigy Insecticides Private Ltd., now incorporated in Messrs. Tata-Fison Private Ltd., Bombay House, Bruce Street, Bombay-1 for the use of the Certification Mark of I.S.I. on D.D.T. Dusting Powders, and D.D.T. Water Dispersible Powder Concentrates.

The following Certification Marks consisting of the monogram of the Indian Standards Institution and number designation of Indian Standards being inscribed in the top side of the monograms, will certify that D.D.T. Powders and D.D.T. Water Dispersible Powder Concentrates conform to all the requirements given in the relevant Indian Standards, namely IS:564-1955 and IS:565-1955 respectively:

The above Certification Marks will either appear in stencilled form on the containers or will be printed

on labels applied to the containers. The containers bearing the Certification Marks of the I.S.I. will convey to the purchaser that the materials have been manufactured under controlled conditions and are of the quality laid down in the relevant Indian Standards.

This is the first licence issued to a manufacturer of D.D.T. formulations. It is expected that the D.D.T. formulations of other manufacturers would also be covered by the scheme in due course. India requires large quantities of D.D.T. formulations in combating disease, rearing animals and saving plants from pest nuisance. The production of the materials is continuously increasing. The presence of the Certification Mark on these products would help the consumers in obtaining supplies of ensured quality. If any consumer has any complaint about the quality of D.D.T. formulation bearing the Certification Mark, he may immediately contact the licensee as well as the Indian Standards Institution, Manak Bhavan, 9 Mathura Road, New Delhi.

C.F.T.R.I. NEWS

Visitors

The following distinguished persons visited the Institute during November 1957.

1-11-1957. Sri B. N. Maheswari Dy. Secretary, Ministry of Home Affairs, Govt. of India.

2-11-1957. Housing Ministers of various States and other delegates to the 2nd All-India Housing Ministers' Conference held in Mysore.

Sri K. C. Reddy and Sri A. K. Chanda, Minister and Dy. Minister for Works, Housing and Supply, Govt. of India.

9-11-1957. Mr Kudinoov, Cultural Secretary, U.S.S.R. Embassy, New Delhi.

16-11-1957. Sri M. P. Patil, Minister for Revenue, Govt. of Mysore.

22-11-1957. D. P. Chandaria, Industrialist from Mombasa, Kenya.

28-11-1957. Mr Perrot, Spray-Irrigation Plants, West Germany.

Mr Fritz Ruecker, Resident Representative of Perrot-Spray-Irrigation Plants of West Germany, New Delhi.

During the course of a talk at the Institute on 'Fruits Products Order *vis-à-vis* The Industry in the Southern Zone', Mr J. K. Jagtiani, Marketing Development Officer, Madras, mentioned that the said Order was comprehensive for both the strict hygienic conditions of the factory premises and the definite specifications for the products as also the labels. This Order had accordingly helped the development of Fruit Preservation Industry particularly in the South with emphasis on quality standards and export possibilities.

The speaker added that the action of the Government of India to stop imports of preserved fruit products had given a great fillip to the indigenous industry which is finding greater sales and is also meeting different palates through the evolution of newer types of products which have a wide range and include canned fruits, jams (simple and mixed), jellies, chutneys (sweet and hot), pickles (oil and vinegar), beverages (simple and blended), dried fruits, candy and other confectionery-like products. Revealing the present status of the Industry in the South, he stated that 35 lakhs of rupees worth of fruit products are being manufactured and out of this Bangalore alone contributes 13 lakhs, Trichur 10 lakhs and Bhodinyakanur one lakh. The Loan Schemes of the Government (Central and State) which are primarily based on the supply of machinery on hire-purchase basis to help starting the new fruit preservation factories have given a great impetus to the development of this Industry in the country.

Referring to the work of the Institute Mr Jagtiani concluded that the experimental findings at the Institute need to be transferred to

the factories sooner in order to put the Industry on a more scientific basis.

Appointments and Postings

Senior Scientific Officer

Sri K. M. Dastur (Information and Statistics Division).

Junior Scientific Officers

Sri Y. S. Lewis, Sri N. Subramanian (Processing Division).

Participation in Exhibitions

The Institute participated in the Exhibitions organized in connection with the 15th World Vegetarian Congress at Delhi and Madras during November 1957. Distinguished visitors from abroad and India visited the stalls and evinced keen interest in the various products and processes standardized by the Institute.

General

The following members of the Central Fruit Products Advisory Committee attended its Annual Meeting held at the Institute from 28th to 31st October 1957.

1. Sri Madan Lal, (Delhi).
2. Sri Manohar Lal Aroua, (Lucknow).
3. Sri N. S. Pochkhanawala, (Bombay).
4. Sri Vittal Mallya, (Bangalore).
5. Sri H. C. Bhatnagar, (Nagpur).
6. Sri B. B. Sardeshpande, (Bombay).
7. Sri Jal Bhiladwala, (Pardi).
8. Sri O. T. Variedh, (Trichur).
9. Dr Girdhari Lal, C.F.T.R.I.
10. Sri P. H. Bhatt, Directorate of Marketing and Inspection.

Addressing the Committee, Dr V. Subrahmanyam welcomed the idea of holding the meeting at this Institute after a lapse of 3 years when almost all the members met in connection with the Symposium organised by this Institute. He continued that during this period, the postgraduate training

in Fruit Technology had been converted from a Diploma Course to an Associateship course. Steps were being taken to assist the industry in examining their products and rendering technical advice at nominal charge. Besides, arrangements were also afoot for sending the scientific and technical staff to visit more factories and assist them on the spot in their day-to-day problems. Organization of demonstration at the exhibitions and short courses as a part of the Extension Service Unit were helping to awaken the masses and making them more preserved-food-minded. The generous donation of the Metal Box Co. in the form of gift of a demonstration van was a good gesture of the industry's desire to have closer collaboration with the work of this institute. The Institute was gradually being seized of the problems arising out of patents for various processes and products developed at the Institute and relaxation in many ways were being made to avoid them. In view of the fact that such a meeting provides ample opportunities for the preservers—big and small—to have a first hand knowledge of the work of the Institute, it was hoped that the committee will make it a regular annual feature.

List of papers published

641. **Substitute foods**, by Bhatia, D. S. and Bains, G. S., *Food Manuf.*, 1956, 1.

642. **Spin Pasteurizer—its principle, performance and industrial applications**, by Pruthi J. S., *Food Sci.*, 1957, 6 (8), 179.

643. **Food grains from tapioca**, by Subrahmanyam, V., *Food Sci.*, 1957, 6 (8), 183.

644. **Some aspects of the Australian fish processing industries**, by Moorjani, M. N., *Food Sci.*, 1957, 6 (8), 185.

645. **Screening of carbohydrates for sporulation of bacilli in fluid medium**, by Majumder, S. K. and Padma, M. C. *Canad J. Microbiol.*, 1957, 3, 640.

Food Abstracts

This section contains abstracts of papers and articles on Food Technology and is divided into two parts. The first part contains abstracts of papers on food technology published in scientific journals in India. The second part comprises abstracts of important scientific papers published in foreign journals, including those in modern European languages. The abstracts have been so selected as to serve the needs of food and allied industries in India.

PART I (Indian)

ANALYTICAL

Determination of saturated acids by direct acetic acid-acetone-permanganate oxidation of mixed fatty acids, by Kartha, A. R. S. and Narayanan, R., *Indian J. agric. Sci.*, 1957, **27** (Part I), 73.—It has been shown that heavy degradation of stearic acid occurs during aqueous alkaline permanganate oxidation at 95-96°C, saturated fatty acids undergo similar degradation on oxidation with permanganate in acetone solution. A new technique has been developed which eliminates such changes. The technique has been successfully used for the oxidative destruction of unsaturated acids in mixed acids, without affecting higher saturated acids.

A new procedure is outlined to determine the saturated acid content in small amounts of mixed fatty acids by acetic acid-acetone-permanganate oxidation and Bertram separation of the oxidation products. Comparative results for six fats are given. The saturated acid content of a number of natural fats has been determined by this procedure.

The technique also provides a rapid method for accurate determination of linoleic acid in small quantities of mixed fatty acids.

BIOCHEMISTRY AND NUTRITION

Indophenol-reducing substances in palm gur, by Hatwalne, B. V. and Kamala Sohoni, *Ann. Biochem. exptl. Med.*, 1957, **17** (2), 45.—Many samples of palm gur contain a high concentration of ascorbic acid which value has been shown to be due to the presence of true ascorbic acid as well as other

indophenol-reducing substances which may be called as 'apparent' ascorbic acid. The AA have investigated into the nature of these indophenol-reducing substances both by chemical and paper chromatographic methods. The true and 'apparent' ascorbic acid values have been determined by the formaldehyde and ascorbic acid oxidase methods. The results obtained in the two methods have been reported to agree. The nature of the non-specific reducing substance has also been studied by the methods of Mapson and Levy, which are particularly applicable to the estimation of ascorbic acid in presence of reductones. Reductones are generally found in foods which have been processed by heat-treatment. The results serve as an evidence for the presence of reductones. The pH of the gur solution has been found to have a bearing on the dye-reduction value. The observations made on the pH and dye-reduction values show that there is a decrease in the amount of indophenol dye-reduced as the pH of the gur solution decreases, thereby indicating the presence of reductones. Qualitative paper chromatographic analysis of the gur solution substantiated the above results and revealed the presence of four dye-reducing substances in palm gur. Two of these have been identified by the AA as *l*-ascorbic acid and reductone, while the other two could not be identified.

K.L.R.

Studies on the effect of cooking on the bound nicotinic acid of some pure-bred strains of rice, by Mitra, B. R. and Chaudhuri, D. K., *Ann. Biochem. exptl. Med.*, 1957, **17** (2), 49.—Nicotinic acid has been shown to be in the

bound state in cereals and this bound vitamin will not be available to experimental animals for their growth unless it is pre-treated with mild alkali. The AA have determined the bound and total nicotinic acid of several varieties of rice subjected to different treatments. The rice samples were obtained by dehusking the paddy in a sheller without disturbing the bran of the rice grain. The values for the vitamin in the rice grain in rice after cooking with distilled water and in rice after cooking with tap water have been estimated according to the method of Chaudhuri using *p*-aminobenzoic acid as a coupling agent. It has been shown by earlier work that if the ratio of the amount of total nicotinic acid to that of bound nicotinic acid of a sample of rice is about 3.75, when all the vitamin was assumed to be present in the bound state in the sample. The results of the present study show that (1) the major portion of nicotinic acid is present in the combined state in all the varieties of rice, (2) cooking the rice with distilled water (pH about 6.6) results in the partial removal of the vitamin along with the gruel, but still the ratio between bound and total nicotinic acid in cooked rice remains almost the same as before cooking, and (3) cooking of the rice samples with tap water (pH about 8.4) leads to the liberation of a portion of the nicotinic acid present in the bound form. The pH of the gruel obtained after cooking the rice with tap water did not however change appreciably.

K.L.R.

Dehydroascorbic acid reductase of neera from date palm, by Hatwalne, B. V. and Kamala

sohonic, *Ann. Biochem. exptl. Med.*, 1957, **17** (2), 53.—Several workers have reported the presence of dehydroascorbic acid reductase in plant tissues, in cauliflower juice, pressed pea-juice and also in *neera* obtained from the date palm. The present paper deals with the method of purification and the study of the properties of the enzyme isolated from *neera*. The activity of the enzyme has been measured by the Thunberg technique, the details of which are given. The amount of mg. of ascorbic acid produced in 10 minutes at 28° C by 100 mg. of dry enzyme preparation gives a measure of reductase activity. The activity of the purified enzyme preparation on dry weight basis was about 90-120 times that of the original *neera* and on nitrogen basis, the increase in activity was only nine-fold. The rate of reduction of dehydroascorbic acid (DHA) has been studied by following the reaction of 1 c.c. of purified enzyme solution with 2 mg. of DHA in presence of 6 mg. of glutathione (GSH) at pH 6.3 and 28° C. The amount of ascorbic acid formed during the reaction is nearly proportional to time in the first 10 minutes, after which period the rate of reaction decreases. The concentration of DHA and GSH in the above reaction has a bearing on the activity of the enzyme and it is found that the reductase shows optimum activity when DHA concentration is 2 mg. and GSH is 6 mg. in 10 c.c. of the reaction mixture.

The AA have also investigated the effect of temperature, pH and introducing hydrogen donors in place of glutathione on the reductase activity. The results show that the dehydro-ascorbic acid reductase from *neera* has a maximum activity at 40° C and pH 6.8 beyond which rapid inactivation takes place. Among the hydrogen donors tried *viz.* cysteine and thioacetic acid, neither was found to be capable of replacing glutathione as hydrogen donor. The enzyme activity was not at all affected by KCN and H₂S which are known

to be typical inhibitors of ascorbic acid oxidase while 10⁻³ M sodium azide and 10⁻³ M iodoacetate completely inhibited the activity. Studies on the stability of the reductase during storage at 0° C and 28° C in solution and lyophilized solution show that the purified enzyme preparation when preserved at 0° C after lyophilization retained most of its activity in varying degree upto nearly 16 days.

K.L.R.

DAIRYING

Studies in physico-chemical properties of milk, Part VII. Heat of flocculation of milk at the isoelectric point of casein, by Puri, B. R., Sharma, L. R. and Chandra, R., *Indian J. Dairy Sci.*, 1957, **10** (2), 79.—A sensitive calorimetric arrangement for determining heat of flocculation of milk at the isoelectric point of casein has been standardised. The heat of flocculation was measured in the case of a number of samples of milk obtained from different animals of different species. The presence of fat had no effect on this value which was found to be a function of the casein content of milk. A straight line relationship between the two quantities permits the determination of casein from the thermal effect. The investigations show that the degree of dispersion of casein in almost all types of milk is practically identical.

FISH

Pilot plant for the production of fish meal, by Krishna Pillai, V., *Res. and Ind.*, 1957, **2**, (10), 265.—The deficiency of high grade animal protein in the Indian diet can be met by supplementing the diet with a cheap and nutritious source like the shark fish. The main objection in using this, however, is the off-flavour of the shark meal. The A. describes the details of the pilot plant which has been set up at the Mandapam Fisheries Research Station to produce odourless quality fish meal from shark and other non-oily types of fishes. The pilot plant consists mainly of three parts *viz.*, a treatment

chamber, a drying chamber and heat source. The details about the design and fabrication of these are given. Minced fish flesh treated with fermenting media is heated with sufficient quantity of water for 15-30 minutes. When the fish coagulates, it is taken out of the chamber and excess moisture pressed out using a hand press leaving a moisture content of about 45 per cent. The pressed cake is dried in steam jacketed rotating drier through which hot air is passed at 200° C. Pilot plant trials have shown that temperatures between 150-200° C are best suited for the production of quality fish meal. Raw fish is converted into dry powder within 3 hours. Fermentation period should not exceed 1½ hours in the case of shark and otherwise ammonia is formed while longer periods have been found suitable in other fishes. The entire plant with a capacity of holding 100 lb. of raw flesh is said to cost about Rs 500 inclusive of accessories like electric motor, hand press, mincer and powdering machine. The cost of treatment of the flesh is also negligible, being of the order of 50 nP. per 100 lb. of shark.

K.L.R.

INSECTICIDES

Insecticidal property of the fungus, *Ganoderma Lucidum* attacking palms, by Seshagiri Rao, *Curr. Sci.*, 1957, **26** (10), 325.—In this note, the A. describes the effect of the fruit-body of the fungus *Ganoderma Lucidum* against rice weevils. The fruit-body of the fungus was ground well with kerosene oil (1 lb. in 1 gallon) and the resulting extract (11 per cent) was diluted to 5.5 per cent, 2.75 per cent and 1.375 per cent by adding kerosene oil. The clear liquid of the different strengths was sprayed on a known population of rice weevils and the percentage of mortality was observed after 24 hours and 48 hours of the treatment. A control experiment was carried out with kerosene oil spray alone. The results show that the *Ganoderma* extract of 11 per cent, 5.5 per cent

and 2.5 per cent strength produces high mortality of the weevils. 2.5 per cent of the weevils killed in 24 hours with extract of 5.5 per cent strength as compared to 26 per cent mortality in kerosene oil (control,) comparing well with pyrethrum extract, which is extensively used as an indoor spray material.

K.L.R.

Contamination of stored food grains with insecticides, by Lingale, S. V., *Indian J. agric. Sci.*, 1957, 27 (Part I), 125.—The contamination left in treated grains stored in jute bags by dusting the surface of the bags with BHC powder as recommended by Sontakay has been investigated under laboratory and warehouse conditions. In the laboratory, the bags filled with wheat were dusted without any pressure at the rate of 6, 8 and 10 oz./100 sq. ft. Wheat samples were drawn from the bags at the end of 3, 6, 9 and 12 months storage and the BHC content in the grain was estimated. In the warehouse, the jute bags filled with wheat were piled in rectangular stacks of 1700-2000 bags each (vertical layers—15) and the BHC was applied to the outside, surfaces of the stacks at the rate of 9 oz./100 sq. ft., area of the stack. Samples were drawn from different layers of the stack at the end of 3 and 6 months. The BHC concentration in each of the wheat samples was determined by extracting the sample with ether in a soxhlet, dehydrochlorinating by monoethanolamine and estimating the chlorine content by Volhard's method. The amount of BHC was calculated from the chlorine value. The results show that mere surface dusting does not leave heavy residues in the grains and residues observed are not injurious to consumers. Analysis of grain samples from treated bags available to consumers in different shops, however, showed the presence of large quantities of the insecticide in some lots. This heavy residue might be due to the practice of mixing grains spilled on the treated floors with the grain in

the bags at the time of selling. The use of lindane which has a much higher potency towards insects and which reduces the toxicity hazard to the consumers has been suggested in place of BHC.

K.L.R.

MICROBIOLOGY

On the antifungal action of some natural coumarins, by Chakraborty, D. P., Das Gupta, A. and Bose, P. K., *Ann. Biochem. exptl. Med.*, 1957, 17 (2), 59.—Coumarins are known to possess fungistatic properties. The AA have, therefore, studied the effect of 17 natural coumarins of Indian origin towards the fungi, *curvularia lunata* and *Aspergillus niger*. The substances were used in varying concentrations from 2×10^{-2} to 2×10^{-4} M and the antifungal activity has been measured by the usual agar-plate method. The results indicate that the compounds in general showed more inhibitory action against *C. lunata* than against *A. niger*. The most pronounced antifungal action against *C. lunata* is found in the case of four compounds, viz., psoralen, seselin, luvangetin and xanthyletin of which the last three are chromenoaldehydes.

K.L.R.

Studies on ramnacin, by Ahmed, K. and Islam, M. F., *Ann. Biochem. exptl. Med.*, 1957, 17 (3), 91.—The AA have isolated earlier from a *streptomyces* sp. a new antibiotic called ramnacin which was active against gram-positive and gram-negative bacteria and also certain fungi. In this paper, results of the work relating to the optimum conditions for the production of the antibiotic are reported. The effects of different extracts of natural substances such as corn, Bengal gram, soyabean, rice, beef and yeast, of different carbon sources like lactose, glycerine, starch, sucrose, dextrin and dextrose and of trace inorganic ions like molybdenum, boron, manganese, zinc and iodine were studied with a view to get a maximum yield of the antibiotic in surface culture. The relative merit of shake and

stand culture was also investigated. The antibiotic was assayed by the cylinder plate method using *Bacillus subtilis* NCIB 3610 as the test organism. Of the natural extracts, the presence of Bengal gram extract in the culture medium was found to give the maximum yield on the 18th day of the culture which was maintained thereafter. In the case of the influence of carbon sources in the culture media, it was observed that on the 18th day of culture, when maximum antibiotic activity was shown, the increase in the activity over the control experiment was 80.6, 80.6, 77.8, 55.6, 72.2 and 33.3 per cent for glycerine, lactose, sucrose, dextrin, starch and dextrose respectively. Of the trace elements tried, iodine, zinc and manganese when present at 2 p.p.m. level produced maximum activity within 18 days of culture. The results show that good yield of the antibiotic is obtained with glycerine (as carbon source), gram extract, trace (2 p.p.m.) of iodine, manganese or zinc present in the culture medium. The shake culture was found to be more efficient, as maximum production of the antibiotic was obtained in the shake culture within 10 days while in stand culture, it took about 18 days.

K.L.R.

Oxygen transfer in submerged fermentation of *Penicillium chrysogenum* in industrial fermentors, by Gondhalekar, R.S. and Phadke, R. S., *J. sci. industr. Res.*, 1957, 16C (9), 188.—The variation of the specific oxygen diffusion rate in industrial fermentations has been measured by estimating polarographically the concentration of dissolved O_2 in the broth fluid and the specific O_2 uptake rate of the mycelium. Penicillin titres in batches with higher mycelium content and higher values of specific O_2 diffusion rates are found to be higher.

Studies on the reduction of tetrazolium by lactic acid bacteria. 3. Influence of pH and composition of medium, by Laxminarayana, H., Sreenivasamurthy, V. and Iya, K. K., *Indian*

J. Dairy Sci., 1957, **10** (2), 49.—The influence of pH and composition of the medium, with particular reference to the sources of nitrogen and carbon and B-complex vitamins on the reduction of triphenyl tetrazolium bromide to formazan by lactic acid bacteria has been studied.

Among the sources of nitrogen examined, papain hydrolysed casein was found to favour the maximum growth and reducing activity (as indicated by the amount of formazan produced in the medium) of most of the organisms. With different sugars as sources of carbon the organisms exhibited significant differences in their reducing capacities which generally reflected their relative fermentative abilities. One of the organisms (*S. faecalis*-190) was found to cause appreciable reduction of tetrazolium even in a carbohydrate-free medium, which was in some way associated with the utilization of cysteine.

Most of the organisms required the presence of one or more of the B-complex vitamins (particularly riboflavin) in the medium for bringing about reduction of tetrazolium. Cultures of *S. faecalis* and *L. plantarum*-89 (heterofermentative strain) were found to give a linear response in their reducing activity to the addition of graded doses of riboflavin.

The streptococci generally showed maximum reducing activity at the pH range of 6.3 to 6.8 while the lactobacilli were active at lower pH values. One organism (*S. citrophilus*-209) which did not show any reducing activity under ordinary conditions, was able to cause reduction of tetrazolium when the pH of the medium was raised to 6.7 or 7.0 by adding alkali.

Some observations on the influence of various substrates and metabolic compounds on the reduction of tetrazolium by 'resting' cells of *S. faecalis* and *S. citrophilus* has also been made. Addition of sulphhydryl compounds to glucose caused a marked increase in the reducing activity of *S. faecalis* and the reduction was found to be proportional to the amount of—SH

compounds added. The culture of *S. citrophilus* was able to show reduction of tetrazolium only when lactate was used as a substrate.

Studies on the heat-resistance of some streptococci, by Krishna Iyengar, M. K., Laxminarayana, H. and Iya, K. K., *Indian J. Dairy Sci.*, 1957, **10** (2), 90.—Some bacteria survive even at high temperatures during heat-treatment of dairy and other food products. The resistance or susceptibility of these bacteria depends on various factors such as time and temperature of heat-treatment, concentration and age of cells in the medium and composition and pH of the medium. The AA have studied the factors which govern the heat resistance or susceptibility of bacteria in relation to milk processing techniques using four species of streptococci viz. *S. lactis*-57, *S. liquefaciens*-108, *S. faecalis*-190 and *S. thermophilus*-240 which were isolated from dahi. The cells were inoculated into three media viz., skim milk, tryptone broth and physiological saline and the suspensions were treated at different temperatures for varying periods. The heat resistance of the organisms was determined by following the growth and activity of the surviving cells when subcultured in litmus milk. The effect of initial cell count, age of the culture (6 and 24 hours old) and the composition and pH of the medium on the extent of survival of the organisms when the media were heated to 63°C for varying periods. The results have been given in different tables. In general, all the factors have a significant influence on the heat resistance of the organisms. Among the organisms studied, *S. lactis* was found to be least resistant being completely destroyed by heat-treatment at 63°C for 5 minutes irrespective of the environmental conditions. *S. faecalis* and *S. liquefaciens*, though heat resistant could be destroyed at 63°C in 30 minutes when the cell concentration was less than 50,000 per ml. *S. thermophilus* exhibited the highest resistance and its complete

destruction could be effected only when the pH of the medium was lowered to 5.0. The results indicate that the efficiency of heat processing in reducing the bacterial population and improving the storage quality of milk and other food materials depends on the nature and number of the organisms present in it as well as the age of the cultures, both of which are influenced by the conditions of production and storage of the raw material.

K.L.R.

OILS AND FATS

An improved method for direct estimation of free tocopherol in small quantities of oilseeds, by Sethi, A. S. and Kartha, A. R. S., *Indian J. agric. Sci.*, 1957, **27** (Part I), 49.—Methods of estimation of tocopherol involving saponification of fats and extraction of unsaponifiables are recognised to be somewhat inaccurate due to various sources of error which cannot be eliminated. The direct estimation of free tocopherols in oils has hence been investigated in detail.

The nature and mechanism of inhibition in the direct estimation of tocopherol in oils and fats by the Emmerie and Engel's method was studied. Inhibition is produced only by unsaturated acids and their derivatives and it is caused by the oxidising action of fat peroxides usually present in these; the degree of inhibition produced by any oil will hence vary with its peroxide content. Alkali metal salts of some organic acids also inhibited the colour formation to some extent. Free fatty acids, saturated as well as unsaturated, even when carefully purified from last traces of tocopherol produced a certain amount of colour on mixing with the Emmerie and Engel reagent; this colour is, however, additive. Degree of inhibition produced by fats is lower when fats are comparatively fresh, and when undamaged seeds are extracted in the cold with sulphuric ether freed from peroxides, the resulting fats show no inhibition at all. On the basis of

the above results a rapid method has been developed for direct estimation of free tocopherols using ca. 0.1 to 0.3 g. of seeds or about 40 mg. of oil. The free tocopherol contents of some 20 different varieties of common Indian oils determined by the above method are given.

A simple method has been developed for the qualitative detection of inhibition.

PACKAGING

Boards and moulded products from sawdust and agricultural wastes, by Narayanamurthi, D. and Joseph George, *Res. and Ind.*, 1957, 2 (8), 213.—The AA reported earlier the possibility of preparing boards from lignocellulosic materials attacked by wood destroying fungi using cheap chemicals. In the present paper, the method of preparation and properties of boards and moulded products from sawdust and agricultural wastes such as tapioca stems, bagasse, linseed straw, jute stalks, corn cobs, nut shells and tea waste. The boards are made by adding activator (such as organic acids, phenolic substances, pine needles, mild alkalies like lime and sodium carbonate, furfuraldehyde, magnesium chloride, acetic acid etc.) to the finely powdered lignocellulosic materials and pressing the well mixed mass at about 800 lb. per sq. inch and 160°C., the time of pressing depending on the thickness of the board required. About 30 minutes are enough for boards of 3/16 inch thickness. The bending strength, resistance to drops from different heights, moisture absorption and swelling as indicated by the soaking test have been studied with the resulting boards and the results are given in a table. The results indicate that boards with good properties can be obtained by the above process. Tamarind fruit, pine needles and other fruits and

leaves as natural activators give satisfactory results. Boards made out of saw dust have good water-resistance. The feasibility of producing boards of pleasing appearance which can be used for partitions, ceiling, almirahs, table tops etc. has been shown. Moulded articles of attractive design can also be made.

TEA

Utility of the ethyl acetate extractives in the analysis of tea, by Mitra, S. N. and Chatterji, R. K. *Sci. and Cult.*, 1957, 23 (3), 152.—Hard stalk and stems and spent tea are generally used to adulterate tea leaves. The presence of these adulterants can easily be detected by finding out the amount of ethyl acetate extractives present in the tea infusion. Catechins which are present in tea are extracted out by ethyl acetate giving a reddish brown coloured extract. Hard stalks and spent tea contain much less of these catechins and as such their presence in tea decreases the colour grade of the ethylacetate extract and the amount of solids in it. The test is carried out by shaking 15 c.c. aqueous infusion of tea with an equal volume of pure ethyl acetate for 1 min. in separating funnel. The ethyl acetate layer is separated and clarified with 1 c.c. of absolute alcohol and the brown colour is measured in an 'EEL' photometer using the blue filter No. 621 and adjusting the photometer to zero with pure ethyl acetate as blank. Gravimetric estimation is also done by shaking 25 c.c. of aqueous tea infusion with an equal volume of the reagent for 1 minute, evaporating the ethyl acetate layer and drying it at 70-80°C. The wt. of the residue multiplied by 400 gives the percentage of ethyl acetate extractives in the dry tea sample. Crude fibre has also been estimated. The results show that the depth of brown colour of the ethyl acetate

layer and the percentage of extractives decrease as the crude fibre increases (i.e. increase in hard stalks). The EEL reading also decreases in the case of exhausted tea. The colorimetric test is simple and rapid and can, therefore, be used as a sorting test in the analysis of tea.

K.L.R.

K.L.R.

GENERAL

Isolation of 'niacinogen' from wheat bran, by Das, M. D. and Guha, B. C., *Sci. and Cult.*, 1957, 23 (3), 156.—The AA have isolated earlier the bound form of nicotinic acid from rice bran in a crystalline state and this was termed 'niacinogen'. In their present investigation, they have used wheat bran which also contains nicotinic acid, in place of rice bran. Wheat bran is extracted with N/10 HCl and the extract treated with 3 volumes of acetone. The inactive materials which precipitate are removed by centrifuging and the clear centrifugate is treated with a mixture of acetone and ether when the bound vitamin is precipitated. The precipitate is dissolved in 65 per cent alcohol and centrifuged. The process of precipitating with acetone-ether and extracting with alcohol is repeated. Finally, the purified precipitate is dissolved in the minimum quantity of water and fractionated on a cellulose column using phenol-water as the developing solvent. Niacinogen moves with the brown spot down the column. The brown phenol-water fraction is precipitated, with acetone-ether in cold. The precipitate is washed with acetone-ether, dried and crystallised from cold water in a vacuum desiccator. Crystals of niacinogen were formed and on analysis the values for the elements were found to be the same as in the case of rice bran. The yield of niacinogen was 40-60 mg. per 100 g. of wheat bran.

K.L.R.

PART II (Foreign)

ANALYTICAL

A rapid method for the determination of calcium and magnesium in plant material by titration with disodium ethylenediaminetetra-acetate, by Padhye, V. P., *Analyst*, 1957, **82** (978), 634.—Rapid removal of interfering ions from the extracts of plant ash enables improved end-points to be obtained in the determination of calcium and magnesium by titration with disodium ethylenediaminetetra-acetate without the introduction of time-consuming purification procedures. Phosphate is removed by precipitation with zirconium nitrate and iron, manganese and traces of the heavy metals are extracted with carbon tetrachloride as their diethyldithiocarbamate complexes. The results obtained by the method compare favourably with those obtained by conventional methods and recovery of added calcium and magnesium is excellent.

BAKERY

Factors affecting colour stability of stored sugar cookies, by Griffith, T., Johnson, J. A. and Northam, J. I., *Cereal Chem.*, 1957, **34** (3), 153.—The effect of several atmospheric factors on colour stability during storage of dextrose and sucrose sugar cookies was studied. The cookies containing 5 per cent dextrose were initially brown in colour due to the Maillard reaction, whereas the sucrose cookies essentially lacked brown pigments.

Storage of cookies containing dextrose in a high relative humidity for 42 days caused the darkness of the colour to decrease, whereas colour changes in the sucrose cookies were slight. The fading of the brown colour is closely related to the relative humidity.

Changes in the colour also depended on the gaseous atmosphere in which the sugar cookies were stored. At 10 per cent relative humidity (R. H.), the effect of gaseous atmosphere was slight, but at 24 per cent R. H., decrease in

darkness of the dextrose cookies was greatest when the cookies were stored in carbon dioxide, significantly less decrease in darkness was observed when the cookies were stored in oxygen and nitrogen.

Changes in the colour of the cookies were related to the temperature of storage. Cookies stored at 10 per cent R. H. were not affected significantly by storage temperatures. The sucrose cookies stored in 34 per cent R. H. at 25°C. and 38°C. exhibited no significant decrease in darkness, while at 70°C the cookies became increasingly brown as the time of storage was extended. A significant effect of temperature was exhibited on dextrose cookies stored in 34 per cent R. H. Storage at 25° and 38°C resulted in a loss of colour, while storage at 70°C. resulted in an initial loss of colour followed by an increase in darkness of colour. The development of the brown colour in the 'dry state' appears to occur during storage of cookies and depends primarily on humidity and temperature.

Relation of the browning reaction to storage stability of sugar cookies, by Griffith, T. and Johnson, J. A., *Cereal Chem.*, 1957, **34** (3), 159.—The effect of products of the browning reaction on fat stability in stored sugar cookies was studied. These compounds were characterized by various methods.

It was demonstrated that the addition of 5 per cent dextrose to sugar cookies produced a marked browning in the cookies and these cookies exhibited greater stability to oxidative rancidity than cookies in which no browning occurred.

Lyophilized water extracts of the browned sugar cookies and a synthetic glycine-dextrose browning reaction mixture exhibited antioxidant properties. Extracts of cookies in which little or no browning occurred demonstrated very limited antioxidant properties. Antioxidant properties were associated with the presence of reductones formed during the browning reaction.

Specific tests demonstrated a relationship between the concentration of reductones in sugar cookies and model systems and antioxidant properties.

Effect of baking on the nutritive value of proteins in rye-bread with and without supplements of non-fat dry milk and of lysine, by Anne-Sofie Stromnaes and Kennedy, B. M., *Cereal Chem.*, 1957, **34** (3), 196.—The protein quality of rye bread and of the unbaked ingredients, containing 0 and 6 per cent nonfat dry milk and 0.166 per cent l-lysine, was determined by rat-growth studies. Supplements of milk solids increased the protein efficiency ratio 9 per cent for the bread and 11 per cent for the unbaked ingredients. Lysine increased the protein efficiency 21 per cent both for the bread and the unbaked ingredients. The protein quality of the breads was lower than that of the unbaked ingredients.

BIOCHEMISTRY AND NUTRITION

Dephosphorylation of casein by plant phosphatases, by Sampath Kumar, K. S. V., Sundararajan, T. A. and Sarma, P. S., *Enzymologia*, 1957, **XVIII** (4), 228—Soybean and groundnut seeds have been found to contain a phosphatase capable of dephosphorylating casein. The enzyme has been purified from these sources and has been characterized on the basis of studies on its substrate specificity, pH optimum and behaviour towards metal ions and some reducing agents. From these studies it is concluded that the enzyme is similar to the citrus fruit phosphatase described by AXEL-ROD, but different from the phosphoprotein phosphatase present in mammalian tissues.

Phosphoprotein phosphatase in rat tissues, by Sundararajan, T. A. and Sarma, P. S., *Enzymologia*, 1957, **XVIII** (4), 234.—The distribution of phosphoprotein phosphatase in several tissues of

the rat and the purification of the enzyme from these sources have been described.

Rat spleen has been found to be the richest source for this enzyme. Good yields of the preparation with high specific activity were obtained during purification of the enzyme from rat spleen.

The purified preparation from rat spleen is devoid of phosphomono-esterase and proteolytic activity.

The enzyme dephosphorylates all the phosphoproteins tested and is hence a true phosphoprotein phosphatase.

From the pH-activity and substrate concentration-activity studies it is concluded that the alpha- and beta-forms of casein are dephosphorylated by a single enzyme.

These studies definitely show that the phosphoprotein phosphatase activity of tissues is not due to a combination of proteolytic and phosphomono-esterase activity.

Nutritional improvement of white flour with protein and amino acid supplements, by Deshpande, P. D., Harper, A. E. and Elvehjem, C. A., *J. Nutr.*, 1957, **62** (4), 503.—Rate of growth of young rats was increased from 3 to 21 g/wk. when their diet, containing 78 per cent of white flour was supplemented with 0.5 per cent of L-lysine and 0.4 per cent of DL-threonine. Further improvement in growth was obtained only when 7 more essential amino acids were added.

Although lysine was limiting for growth, liver fat did not accumulate when the diet contained 78 per cent of white flour. However, fatty infiltration, which occurred when the flour was fed at a 5.4 per cent protein level, was prevented by a lysine supplement.

Maximum growth was obtained when intact protein formed part of the supplements but growth was not as rapid when the protein was replaced by equivalent quantities of crystalline essential and non-essential amino acids.

Utilization of amino acids from foods by the rat, IV.

Tryptophan, by Lushbough, C. H. Porter, T. and Schweigert, B. S., *J. Nutr.*, 1957, **62** (4), 513.—Experiments were conducted to provide a test procedure for the quantitative evaluation of the utilization of tryptophan from foods using the male weanling rat. The method developed is of short duration and provides an adequate range of response to tryptophan supplementation of the diet. A tryptophan-deficient basal ration composes of 10 per cent of oxidized casein plus 4 per cent of untreated casein, supplemented with cysteine, methionine, and tyrosine, was used. The weight gain of rats fed the basal ration plus graded levels of 1-tryptophan or known amounts of tryptophan in foods, was used as the criterion for determining the quantitative utilization of tryptophan from those foods. The repeatability of the results using different levels of the test foods, after varying experimental periods, and in independently repeated experiments gives support to the validity of the methods employed. Attempts to obtain improved growth response with supplements of niacin and threonine resulted in decreasing tryptophan utilization values as the amount of test food was increased.

The percentage of tryptophan utilized for growth of the male weanling rat when fed raw and roast beef, ham and lamb, nonfat dry milk, overheated soybean meal, and split peas ranged from 75 to 107 per cent. Tryptophan utilization results for unheated and normally-processed soybean meals, and rolled oats ranged from 117 to 132 per cent. The results suggest that cooking or heat processing may result in reductions in the availability of tryptophan to support growth. The percentage of ingested tryptophan excreted in the feces ranged from 1 to 10 per cent.

The high values observed for tryptophan utilization in these studies gain added significance when compared to those observed in the earlier studies on lysine and methionine. The ranges in the

observed amino acid utilization values for the foods tested were 49 to 98 per cent for lysine, 48 to 83 per cent for methionine, and 75 to 132 per cent for tryptophan.

DAIRY

A rapid method for the determination of lactose in milk and cheese, by John, A., Barnett, G. and Abdel Tawab, G., *J. Sci. Fd. Agric.*, 1957, **8** (7), 437.—A colorimetric method is described for the determination of lactose in milk and cheese. It appears to be both speedy and accurate, as is evidenced by the facts that a lactose determination in milk takes about 15 min. to complete, while suitably designed experiments indicate a satisfactory degree of recovery of lactose. As illustrations of the potential uses of the method, figures are given for the lactose content of different types of cheese at different stages of maturity and for milk undergoing the process of souring.

FISH

A rational procedure for the hot smoke-curing of fish, by Filgner, D. J., *Food Manuf.*, 1957, **32** (7), 365.—Applications of certain physico-chemical criteria for rationalising the hot smoke-curing method which until recently was a method of trial and error are discussed. Conditions for realising in practice the three fundamental requirements, viz., (a) the partial drying of the animal product to remove 15-30 per cent of the water content, (b) the thermal denaturation of the 'raw' proteins for the animal tissue to acquire palatability and (c) the smoke-curing of the product to improve its colour and palatability as well as keeping quality are examined. The internal meat temperature should not exceed 170-180° F and partial drying of the product should be conducted with reference to this temperature. Mention is made of definite parameters to improve the quality and the storage value of the smoked product in respect of three species of fish.

B.V.S.

FRUIT AND VEGETABLE PRODUCTS

The non-volatile organic acids of lucerne, by Richardson, A. and Hulme, A. C., *J. Sci. Fd. Agric.*, 1957, **8** (6), 326.—The organic acid pattern of lucerne has been re-investigated by a combination of ion exchange and partition chromatography. The following acids were found to be present: l-malic, malonic, succinic, alpha-ketoglutaric, fumaric, glyceric, pyrrolidonecarboxylic, shikimic and quinic. The presence of citramalic and glycollic acid was also indicated. An unidentified dibasic acid, $C_7H_9O_5$ was also indicated.

Carotene in the leaves of the carrot, by Booth, V. H., *J. Sci. Fd. Agric.*, 1957, **8** (6), 371.—Leaves of carrot plants of cultivated varieties contained an average of 119 mg. of total carotene per kg. fresh weight, or 546 mg. per kg. dry weight. The concentration of total carotene based on averages of many batches was approximately constant through the season so long as the leaves remained healthy in appearance, and except for small seedlings, was independent of the age of the plant. The average concentration was the same during three successive years. In these respects leaves contrasted with roots. There was, however, a variation between individual batches from different varieties, seasons and growing conditions. A measure of this overall variation is given by the standard deviation, 19 mg. per kg. fresh weight. Part of this variation was due to experimental error of the analytical method, and part to sampling. Beyond these there was a residual variation between different batches which has not been explained.

The concentration of leaf total carotene was independent of variety among cultivated types of carrot. There was no correlation between carotene concentrations in leaf and in root although the latter varied several hundredfold in different varieties, which included deep red, orange and white types.

Volatile compounds produced by apples. II—alcohols and

esters, by Meigh, D. F., *J. Sci. Fd. Agric.*, 1957, **8** (6), 313.—Methods have been developed for analysing the volatile alcohols present in the atmosphere of refrigerated gas stores containing apples. Alcohols and esters produced by three different varieties of apple, two resistant and one susceptible to superficial scald, were analysed. No correlation was found between a severe incidence of scald and a high rate of production of volatile compounds. Apples produced volatile alcohols, aldehydes, ketones and esters at a much greater rate in air than in gas storage. Among the alcohols produced by the apples were considerable quantities of ethanol and D-2-methylbutan-1-ol.

The changes in orthophosphate in relation to phytin formation in maturing peas, by Fowler, H. D., *J. Sci. Fd. Agric.*, 1957, **8** (6), 333.—The changes in inorganic orthophosphate in relation to phytin formation in maturing pea seeds of two varieties have been studied by means of a paper chromatographic technique.

The changes appeared to take place in three stages. In the first stage, the orthophosphate content was initially high and fell rapidly, while the phytin content rose. In the second stage, the orthophosphate content rose and the phytin fell sharply but began to rise again at once. In the final stage the orthophosphate fell and the phytin slowly rose. The orthophosphate and phytin contents measured simultaneously by stain areas on chromatograms were negatively correlated and the correlation was significant at the $P=0.03$ level. The bearing of these transformations on the texture of peas is discussed.

The stability of lycopene. I—Degradation by oxygen, by Cole, E. R. and Kapur, N. S., *J. Sci. Fd. Agric.*, 1957, **8** (6), 360.—The rate of degradation of lycopene, the carotenoid pigment normally responsible for most of the tomato colour, by oxygen in solution, has been found to vary according to temperature. Catalytic effect of traces of copper causes marked

increase in the rate of oxidation of solutions.

Solid lycopene has been degraded into small fragments and derivatives of acetone, methyl heptenone, laevulinic aldehyde, laevulinic acid and of an alpha-dicarbonyl probably glyoxal, have been identified by paper chromatography. The possible steps in the course of degradation of lycopene by oxygen have been presented.

S.R.

The stability of lycopene. II—Oxidation during heating of tomato pulps, by Cole, E. R. and Kapur, N. S., *J. Sci. Fd. Agric.*, 1957, **8** (6), 366.—When serum-free tomato pulp is heated in an atmosphere of oxygen, degradation of lycopene takes place. The products of degradation have been found to be similar to the oxidative degradation of lycopene at 50°C which leads to the fragmentation of the molecule giving acetone, methylheptenone, laevulinic aldehyde and probably glyoxal as products.

The rate of break down as measured by colour loss has been found to vary according to availability of oxygen, temperature and intensity of illumination. Acetone and methyl-heptenone appear as volatile degradation products.

S.R.

The effect of alternate freezing and thawing on the total flora of frozen vegetables, by Hucker, G. J. and David, E. R., *Food Tech.*, 1957, **11** (7), 354.—The AA have examined 5,211 individual samplings from 648 samples of commercial frozen peas, string beans, corn, lima beans and spinach. It is concluded that if there is no initiation of the growth in the thawing phase the total bacterial count is not increased during alternate freezing and thawing of the above vegetables. Further, frozen vegetables held at a thawing temperature of 35.6°F would not show an appreciable increase in total flora within 70 hours and in total count when held upto 10 hours. The AA have also shown that the total count as a result of alternate

freezing and thawing would not be significantly affected by the number of bacterial cells present in the original sample before alternate freezing and thawing.

B.V.S.

Pectin hydrolysis in certain fruits during alcoholic fermentation, by Braverman, J. B. S. and Lifshitz, A., *Food Tech.*, 1957, **11** (7), 356.—Various fruits and canning wastes from both fruits and vegetables which contain varied amounts of pectin are used for alcoholic fermentation. During, or probably just before fermentation, some of the pectin substances are hydrolysed into methyl alcohol. The authors have examined experimentally (1) whether the pectin can be demethoxylated by yeast fermentation alone, (2) the reason for widely different methanol content after fermenting one and the same plant material under different conditions of pH and temperature and (3) why two plant materials containing equally large amounts of pectin should differ in the methanol content after fermentation. The experimental method employed is given in detail.

It is pointed out that pectin is not hydrolysed by ordinary baker's yeast or yeast juice and also if the fruit does not contain pectin esterase or if the medium is not contaminated with fungi. The differences in preparation procedures, such as, blanching and thermal treatment, before fermentation, are largely responsible for the wide differences in the methanol content of two plant materials containing equally large amounts of pectin.

B.V.S.

Effect of continuous steam injection of tomato juice on film deposition during subsequent concentration, by Nelson, A. I., Steinberg, M. P., McGik, J. N. and Vetter, J. L., *Food Tech.*, 1957, **11** (7), 406.—In continuation of their study regarding the prevention of film formation on heat exchange coils during the concentration of high temperature hot-broken tomato pulp by the injection of steam into a batch of tomato pulp

upto a pressure of 40 p.s.i.g., the AA have examined the possibility of this steam injection method on a continuous basis. The experimental equipment and methods are dealt with in great detail. Treatments were evaluated by the degree of the film deposited on the heat exchange coils, by the total cooking time, total and soluble solids, weeping and consistency of the product. Steam injection of high temperature hot-broken tomato pulp at 280°F for 3.1 minutes prevented film deposition during subsequent evaporation, resulting in a decrease in concentration time and an increase in evaporation rate. However, the treatment produced a slight adverse effect on weeping and consistency of the concentrated product. It was also found that blanching of the whole tomato prior to hot breaking would reduce the effectiveness of the steam injection treatments by increasing film deposition.

B.V.S.

Studies on preservation of fresh apple juice with sorbic acid, by Furguson, W. E. and Powrie, W. D., *Appl. Microbiol.*, 1957, **5**, 41.—Sorbic acid in low concentrations (0.02—0.04 per cent) which cause no noticeable flavour changes will effectively prevent yeast fermentations in fresh, unpasteurized apple juice. Nevertheless, sorbic acid is not a complete preservative of this product, since control of yeast fermentation created conditions favourable for the growth of acetic acid bacteria which developed after approximately 4 days in non-fermenting juice in incompletely filled or loosely capped containers. The addition of ascorbic acid (at the rate of 50 mg./100 ml. of juice), an antioxidant (in conjunction with sorbic acid), inhibited the growth of these *Acetobacter*, if air was excluded from the containers by complete filling and tight capping. A relatively small air space in the neck of a container was sufficient to permit a limited development of *Acetobacter*. On the basis of these results, it is concluded that fresh, unpasteurized apple juice

containing 0.035 per cent sorbic acid and approximately 50 mg. ascorbic acid per 100 ml. of juice may be preserved without refrigeration for a minimum period of 2 weeks with little loss of flavour or quality.

H.C.S.

The occurrence of *leuconostoc mesenteroides* in potato tubers and garlic cloves, by Smith M.A. and Niven, C. F. (Jr.), *Appl. Microbiol.*, 1957, **5**, 154.—Typical strains of *leuconostoc mesenteroides* were isolated from the inside of potato tubers showing a grayish-black discolouration on the surface as well as the interior. Similar cultures of *L. mesenteroides* were found occasionally inside both normal garlic cloves and those having waxy breakdown symptoms. It appears that these microorganisms are not the primary cause of the wax of breakdown disease.

H.C.S.

INSECTICIDES

Some factors affecting the physical toxicity of fumigants, by Hassal, K. A., *J. Sci. Fd. Agric.*, 1957, **8** (7), 415.—The fumigant toxicities to the grain weevil *Calandra granaria* of 39 alkyl chlorides, bromides and thiocyanates have been estimated with considerable accuracy. The difference between toxicities of isomers on the thermodynamic scale is small except near the cut-off point, or when instability or chemical reactivity are evident. Near the cut-off point, the characteristic sudden rise in the ratio p_t/p_s (toxic vapour pressure/saturation vapour pressure) is more marked the lower the vapour pressure of the isomers, so that a secondary compound may be toxic when the normal one is non-toxic. Vapour pressure may also be a limiting factor for a whole series when the saturation vapour pressures of even the lower homologues are small. For chlorides and bromides, p_t/p_s values change slowly with carbon content below the cut-off member, but for unit saturation vapour pressure the bromides are the more

toxic. When a molecular volume correction factor, V , is introduced, the points for chlorides and bromides form a single line, the slope of which approximates to unity. The equation,

$$\log p_t/V - \log p_s + k',$$

gave better results than

$$\log p_t = b \log p_s + k,$$

when it was applied to various published data, and experimental evidence was therefore found justifying a mainly theoretically derived equation of McGowan.

Experiments using different times of exposure, and with death as the criterion of toxicity, indicated no difference of behaviour between physical and chemical poisons. Doubling the exposure time approximately halved the LD_{50} and hence the p_t/p_s value. This provides further evidence that the arbitrary physical/chemical barrier of $p_t/p_s = 0.05$ has little practical significance.

MICROBIOLOGY

Food perishability: The determination of the vulnerability of food surfaces to bacterial infection, by Clayson, D. H. F. and Blood, R. M., *J. Sci. Fd. Agric.*, 1957, 8 (7), 404.—A technique has been devised whereby the limiting conditions of equilibrium relative humidity and consequently of osmotic pressure, for bacterial growth can be demonstrated, using bacteria in thin films. With *Salmonella typhimurium* and *Escherichia coli* Type I, growth is prevented at and below an e.r.h. of 92 per cent and with *Staphylococcus aureus*, at or below 85 per cent. From the results, it may be deduced that the surface drying that occurs during baking or on exposure of moist foods to normal atmospheres does afford protection against the increase of surface bacterial contamination. The possibility of the production of variants resisting high osmotic pressure cannot be excluded, but no clear evidence of their production was obtained during the present studies.

GENERAL

Tannins—their occurrence and significance, by White, T.,

J. Sci. Fd. Agric., 1957, 8 (7), 376.—The extent to which tannin extract production is itself an agricultural operation is indicated and the distribution of tannins in the plant kingdom discussed. Present knowledge of the nature of the tannins is summarized and illustrated by reference to specific extracts. The problem of the biological origin and function of tannins is discussed, particular reference being made to the effect of these substances on viruses. Brief mention is made of the effect of tannins on soils which they may disperse or aggregate to a marked extent.

Retention of disinfectant activity in the presence of hard water, by Kravitz, E. and Stedman, R. L., *Appl. Microbiol.*, 1957, 5 (1), 34.—The antibacterial activities of the disinfectants *viz.*, representative phenolic and quaternary ammonium compounds are not deleteriously affected by the test water (synthetic hard water of accepted military significance), when used at concentrations which ensure disinfection in the definitive sense.

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